March 1982

A.E. Res. 82-10

An Empirical Evaluation of Alternative Procedures for Determining Agricultural Use Values in New York

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Introduction

Most states have now enacted legislation designed to protect owners of farmland, or other open space from excessively high real property taxes (Davies and Beldon, 1979). To accomplish this objective, the majority of states allow for the assessment of farmland at its value in agricultural use rather than at its full (or market) value (Dunford, 1979).

It is difficult to know what motivated individual state legislators to adopt these measures, but the reasons are undoubtedly diverse. In states where urban pressure is intense, some legislators believe that "use-value" assessment improves the competitive position of agriculture. In New York, state officials argued that "rising property values on farmland surrounding urban areas makes sales of farmland attractive, and corresponding increases in property taxes which may accompany rising farmland values raise farm production costs, thereby making continued farming less profitable and attractive" (McCord, 1978, p. 3). Concerns over the decline in the number of farms and the disappearance of open space near urban areas are probably also reflected by the fact that many states require the owner to commit land to agricultural uses several years into the future in order to receive preferential assessment.

The procedures established for implementing the "use-value" statutes are equally diverse. In some cases, values for farmland are set by a state agency, while in others, the local assessor must set use values. The statutes also contain a range of eligibility requirements and penalties for withdrawal of land from the program (Locken, 1976; Hady and Sibold, 1974; Barlowe and Alter, 1976).

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Much of the material is from Dunne (1981). Additional work to compare his use-value alternatives with the ones implemented in 1981 in New York required a number of assumptions to circumvent data limitations. The implication of these assumptions is addressed and is determined to have little effect on the general nature of the conclusions. The views expressed in the report are those of the authors and do not necessarily reflect the opinion or policy of any agency of the State of New York. Nelson Bills and Lois Plimpton provided helpful comments, but the authors accept responsibility for remaining errors or omissions in the report.

Two general approaches to estimating use values have been applied and they are implemented differently. Under the first, use values are based on the market prices for land which is to remain in agricultural uses (McCord, 1978; Hady and Sibold, 1974). Under the second, agricultural values are tied to the capitalization of land rentals or that portion of farm income attributable to land (Gustafson, 1977; Gustafson and Wallace, 1975; Hull and Marshall, 1979). Some states rely exclusively on one method or the other, while others combine particular features of both. Most statutes leave considerable discretion in designing the estimation procedures to agencies or individuals responsible for setting the values (CEQ, 1976, p. 16; Hady and Sibold, 1974).

This certainly seemed to be the intent of the Agricultural Districts Legislation in New York (L. 1971, C. 479), whereby the State Board of Equalization and Assessment (SBEA) was directed to set agricultural values by considering information on the value of farm real estate, sales values or appraisals. During the first six years of the program, the SBEA established agricultural use values primarily on the basis of a survey of agricultural land sales occurring between 1971 and 1974. Between 1974 and 1979, average yearly increases in the use values were usually under 10 percent and were based on judgment, political considerations and trends in farmland prices as reported by USDA and others (McCord, 1978). In 1979, SBEA repeated the agricultural land sales survey in selected counties and recommended that the agricultural values be increased by an average of 59 percent across the state over the 1978 values (calculations based on data in McCord, 1978). This, coupled with a court ruling requiring the systematic revaluation of all property tax rolls throughout the state, precipitated unprecedented criticism of the "sales-based" methodology and led to two legislative actions. The first, later vetoed by the Governor, was to require that the values for the succeeding two years be increased by a constant 8 percent rather than by the amounts recommended by SBEA. Second, an agricultural unit was established within SBEA and agricultural values were to be based primarily on capitalized incomes, combined with a system of land classification (Conklin and Gardner, 1980).

The purpose of this report is to examine the impact of these significant changes in the way agricultural use values are determined in New York. One major focus is the impact of using different income-capitalization schemes and soil productivity indexes for the use values of different types of agricultural land. Equally important are the implications of the different procedures for the assessment of real property on farms across the state and for the tax bills of farm families. Because of the prominance of dairying in the state's agriculture, attention is focused primarily on the valuation of land used in support of dairy operations in different regions of the state.

To place the study into historical perspective, the second section summarizes New York State's legislative provisions for agricultural use-value exemption. Section three describes the alternative procedures for estimating agricultural use values examined in the study. Section four describes the data used in the study, while section five contains the empirical results. A final section outlines the study's major conclusions and policy implications.

Agricultural Districts Legislation in New York

New York's current legislative provisions for property tax exemptions on agricultural real estate date back to the late 1960's when the Agricultural Resources Commission (ARC) recommended that farmers be granted five-year exemptions from property taxes on all new improvements to farm real estate.1/ The ARC also envisioned the creation of special agricultural districts in areas which were physically well-suited to farming. According to this Agricultural Districts Law, which was passed in 1971 and allowed for use-value assessment of agricultural land:

> It is the declared policy of the state to conserve and protect and to encourage the development and improvement of agricultural lands.... It is also the declared policy of the state to conserve and protect agricultural lands as valued natural and ecological resources which provide needed open spaces... (Agriculture and Markets Law, Section 300).

The Law's Provisions

To accomplish these objectives, the law provides for the formation of agricultural districts, initiated at the local level where landowners prepare a proposal that encompasses a minimum of 500 acres.2/ The proposal may be modified in response to public hearings or reviews by state and local agencies. Upon certification by these authorities, the district is ratified by the county legislative body and becomes subject to all the provisions of the law.

The law facilitates the retention of land in agricultural uses by restricting options usually open to units of governments whose boundaries overlap those of the agricultural districts.

> The district legislation, for example, may supersede local ordinances that regulate farm structures or practices beyond the normal requirements of health and safety. Formation of an agricultural district also modifies, though it does not eliminate, the right of government to acquire farmland by eminent domain. Farmland can be taken for public purposes only after serious consideration has been given to alternative opportunities. The right of public agencies to advance funds for public facilities to encourage non-farm development is modified (Barkley and Boisvert, 1980).

1/ The Legislation has been renewed and the duration of these exemptions was increased to ten years in the 1979 legislative session (Real Property Tax Law, Section 483, Article 4, as amended).

2/ Beginning in 1975, the State has had authority to create districts of a minimum of 2,000 acres or more if the tract is predominantly unique and irreplaceable agricultural lands (Conklin and Gardner, 1979).

State agencies must, within the constraints inherent in standards for health, safety, national defense, and the protection of environmental quality, modify their administrative regulations and procedures to facilitate the protection of agricultural lands.

The law also has the capability of providing direct financial incentives to farmers. One provision limits the power of any special governmental districts to impose benefit assessments or special ad valorem levies on farmland within a district. A final provision allows farmers to pay taxes on land as if the land's value were generated strictly from agricultural use. Those farmers who apply for this exemption are not taxed on that part of the value of their land that is attributable to speculative or developmental purposes. Land that has received this "use-value" exemption is subject to a five-year "rollback" of exempted taxes if the land is converted to a nonfarm use. Farmers must make yearly application for this exemption and, in order to qualify, must have at least ten acres in agricultural production for at least the previous two years. Furthermore, the land must be generating at least $10,000 per year in gross sales, but the value of the farm produce of any rented land may be added to that produced on owned land in order to qualify.[3/] A 1980 amendment allowed owners to apply for exemptions on land rented to others if the rental arrangement was at least five years in duration and the renter's total agricultural operation met the gross sales requirement.

Program Participation

The first agricultural district in New York was formed in Schoharie County in May 1972. By 1978, there were 388 approved districts in the State. These districts encompassed an estimated 5.6 million acres of land, although all districts include a great deal of nonagricultural land within their boundaries. It was estimated that within these districts, there were 16,700 commercial farms, approximately 69 percent of all farms in the state having annual gross sales of $10,000 or more, included in these districts (King, 1979). By July 1981, the number of approved districts had increased to 434, encompassing an estimated 6.4 million acres (Gardner, 1981).

Despite the popularity of agricultural districts and the large percentage of farms included in them, the impact of use-value assessment in New York has not been large. In 1975, there were approximately 3,020 use-value exemptions, representing only 2 percent of the estimated 154 thousand parcels of farm real estate in New York (King, 1978 and Governor's Task Force, 1976). By 1980, the number of exemptions had risen to 10,086.

3/ The law provides for agricultural value assessment to farmers not in a district but who meet the size and gross sales eligibility requirements of district farms and who are willing to make a commitment to keep their land in agriculture for eight years. If any land in a commitment is converted to a nonfarm use while the commitment is still in effect, it is subject to a tax penalty of two times the taxes determined in the year following the breach of commitment. The penalty is levied on the total acreage in the commitment (Conklin and Gardner, 1980).

The limited participation in the program in part reflects the stringent eligibility requirements mentioned earlier, as well as the historical procedures used by local assessing officers in property tax administration. The eligibility requirements are among the most stringent in the nation. A recent study by Boisvert, Bills and Solomon (1980) estimates that at most only 75 percent of the commercially-farmed land in New York is eligible. There is also evidence that much farmland may have been underassessed relative to other classes of property, thus reducing the incentive to apply for the use-value exemption (Governor's Task Force, 1976).

Individual farmers, however, can benefit from the program. The recent decision by the New York Court of Appeals that mandates full-value reassessment statewide is likely to result in higher assessments on agricultural real estate relative to other real property. This could imply significant increases in property taxes on farmland, which could be in part offset by widespread application for the use-value exemption (Boisvert, Bills and Solomon, 1980). The final impact will depend on the speed with which revaluation takes place and the success of current legislative efforts to amend the real property tax law and change the assessment standard (State of New York, 7000, 1981-1982 Regular Sessions, In Senate, June 25, 1981).

Despite the fact that only a small proportion of agricultural land in New York is currently subject to the use-value exemption, SBEA's proposed use values in 1979 were severely criticized by the farm community. Much of the criticism centered around the significant increases in the proposed values over and above the 1978 levels. SBEA recommended that the use value of the most productive cropland be increased by an average of 59 percent across all New York's counties (calculations based on data in McCord, 1978). Some farmers' reluctance to accept these increases was precipitated by a fear that these new values would become the full-value assessments in jurisdictions about to undergo revaluation.

The major criticisms centered on SBEA's "sales-based" approach, in particular on which sales were actually farmer-to-farmer sales and the proportion of the sales price attributable to the land's value in use. Some appraisal experts have argued that even if the prices are devoid of speculative influence, they probably include some additional value added by the farmer to reflect the farmer's role as a long-term investor and a personal hedge against inflation (Suter, 1974). To understand these criticisms, one must examine the theory of land value and the alternative methods of estimating it.

The Theory of Agricultural Land Value

The impact of agricultural value exemptions is inextricably tied to the way in which agricultural use values are determined. Practitioners have two basic approaches available to them: a market methodology and an income-capitalization methodology. Each can be applied in a variety of ways, depending on the type of agriculture, the quality of land and other factors affecting the market for agricultural land. Regardless of the particular variation employed, differentiating between land price and value is complicated by the peculiar nature of the market for land, the implications of which are well known. Equitable and effective implementation of use-value legislation requires an understanding of both approaches and their limitations.4/

The Theory of Value

Adam Smith (1937), one of the earliest commentators on the subject, distinguished between two concepts of value: "value in use" and "value in exchange." The first refers to the ability of a good to satisfy wants while not considering the good's relative plentitude or scarcity. "Value in exchange" refers to market processes where emphasis is placed on relative rather than absolute value.

Other classical economists were concerned with a theory of production and the distribution of returns among factors. Their theory of value was based on "costs of production." The absolute nature of the value of commodities was viewed as being the sum of wages and profits. The "labor theory of value" went one step further and argued that value can be reduced ultimately to the value of the labor which is used in a commodity's production and that which is embodied in the capital employed.

Although critics had perceived inadequacies in the concept of value as an absolute, Jevons' introduction of the "marginal principle" provided the cornerstone of neoclassical economic theory. Jevons based his concept of value ultimately on the ability of a good to provide "utility" rather than on the labor embodied in it or on its cost of production (Jevons, 1911). The utility from the inframarginal unit of the good became the consumer's subjective assessment of its worth; it was therefore possible to establish a relationship between price and quantity demanded for the individual. Many individuals and their respective demands competed in the marketplace for a supply of goods and the interaction of supply and demand established a price at which markets cleared. The market clearing price was the one which reflected the marginal contribution to utility of the last goods traded. Producer goods were handled in a similar fashion, the difference being that they were valued in the marketplace according to their marginal productivity which in turn was ultimately to depend on the contribution of the product to consumer utility.

A common concern for economists was that market prices fluctuated and therefore posed a problem for anyone seeking to discover stable or invariant relationships in economic life. To handle this situation, Smith had developed the concept of "natural price" by which he meant the price resulting from a typical balance between supply and demand; no unusual scarcity or plenty could exist which would afford either buyers or sellers an unusually strong bargaining position (Smith, 1937, p. 55). Closely akin to natural price is Marshall's concept of "normal price." The difference is that Marshall introduced the idea of a "long and short period" into his analysis (Marshall, p. 349). In his long period, prices which are close to production costs are expected to prevail. Wider fluctuations are characteristic of the short period only.

4/ Detailed discussions of the theoretical and empirical problems in implementing either approach in New York are found in Barkley and Boisvert, 1980; Locken, Bills and Boisvert, 1977; and Dunne, 1981.

Thus, Marshall saw the classical theory of value as a special case of a more general theory. In the "long period" the price of a good would be primarily a function of its cost of production, and this was the phenomenon which had occupied the attention of classical economists. Deviations from this "normal price" could not be dismissed as unimportant, however, and a general theory of value would have to explain how and why they arise. The neoclassical theory of value, fully developed in the work of Marshall, allowed for such an explanation.

The Theory of Production

With the development of the neoclassical model, it became possible to relate the value of a factor of production to its contribution in the production of other goods. The foundation of the neoclassical theory of production is the production function.

$$(1) \quad Y = f(X_1, X_2, \ldots, X_n)$$

where Y is the output level and X_1 to X_n are levels of the various factors of production. It is a technical relationship which describes the maximum feasible output from any set of inputs. The determination of the value of each input is based on its marginal product.

$$(2) \quad \frac{\partial Y}{\partial X_i} = \frac{\partial f(X_1, \ldots, X_n)}{\partial X_i}$$

where X_i is the input in question. When calculated for any input at a chosen level, it measures the per-unit contribution to output of an additional unit of the ith input, given levels of all other inputs held constant.

Assuming that both factor and product markets are perfectly competitive, the profit maximizing input and output levels can be determined by maximizing (for given output and input prices P_y and P_i)

$$(3) \quad \Pi = Y(P_y) - \sum_{i=1}^{n} P_i X_i .$$

First-order conditions require that

$$(4) \quad \frac{\partial \Pi}{\partial X_i} = P_y \frac{\partial f(X_1, \ldots, X_n)}{\partial X_i} - P_i = 0 \qquad (i=1, \ldots, n);$$

the value of the marginal product of the ith input (VMP_i) must be equal to its price. Because second-order conditions for profit maximization require that the marginal product of each input be declining, the negatively sloped portion of the value of marginal product schedule is the demand curve for input i in the very short run, the locus of profit maximizing levels of input i for all possible prices of input i. Under certain conditions (linear homogeneous production technology or long-run competitive equilibrium), if all factors are paid the value of their marginal product, total production is just exhausted (Henderson and Quandt, 1980).

This procedure for valuing the flow of services from an input is particularly appropriate for nondurable inputs such as fuel or fertilizer. The value of a durable input (e.g., land) must also reflect the contribution of its entire productive life. Under perfectly competitive conditions, a land rental market reflects the value of a year's service from the land. A market for the sales of the stock of land itself would reflect the future net value of the flow of services over the useful life of the land, discounted appropriately.

If the sales and rental markets for farmland were characterized by perfectly competitive conditions (i.e., many willing buyers and sellers, perfect knowledge, profit maximization behavior, and homogeneous and perfectly divisible units of land), these markets would work well and the relationship between them could be established through the capitalization process. The flow of services from the land, as reflected in rental prices, would be related to the stock of land, and its sale price through the rate of discount. Because these conditions are rarely satisfied in the real world, there are problems in applying these theoretical ideas in estimating agricultural use values. Perhaps the most difficult are the market imperfections.

Valuation Methods

The appraisal of real property is an art, or at best an inexact science. Any two appraisers would probably place different values on a single property, both because of the subjectivity inherent in the process and the appraisal technique which each selected. Appraisals are also conducted for different purposes, ranging from purchases or sales to tax assessments. The different considerations involved in each type of appraisal are likely to result in different estimates of value. In the case of a farm purchase, both the buyer and the lender have a vital interest in the farm's income-producing capability. However, if a farm is being sold for reasons of condemnation, the appraiser's valuation might reflect the highest market price and perhaps a premium for inconvenience to the owner. For tax assessments, the appraiser (assessor) is usually an elected official, and must be primarily concerned with equity in assessment within and among classes of property.

Before the 1930's, appraisers accepted market price as the primary indicator of value. Large price fluctuations during the depression years led to a new distinction between market value and market price; the word "value" referred to "a price which a purchaser is warranted in paying for a property rather than a price for which a property may be sold" (FHA, 1952, Section 1005). After World War II, appraisers regained confidence in market prices. Wendt (1974) argued that, for many classes of property, market prices were especially indicative of value. Markets for urban residential or commercial property are relatively well organized. Even for other types of real estate, he argues that market price is still the best foundation for value because all markets--not just the real estate market--are characterized by some degree of imperfection.

This does not deny other value concepts, it merely distinguishes them from values determined in the marketplace. One such concept is "investment value," which will probably vary between investors according to their assessments of future economic conditions as well as other factors. The concept of farmland use value is perhaps also of this variety in that it refers to a flow of returns from productive activity.

Appraisers have traditionally not been required to estimate anything other than market values. Their services are most often required for a change of ownership involving a market transaction. They have generally "gone to the market" for values. Thus their estimates have had an air of "objectivity" (Pasour, 1979). Income-capitalization and other methods have been retained for use in instances where good market information is not available or where a "check" of the market's operation is thought necessary.[5/]

The Market-Comparison Method

Above it was argued that land would exchange in the market for a price justified by its most productive use, this being an example of the operation of the law of one price (Stocker, 1967). This law is fundamental to the market-comparison method, but in actual exeprience, the single price is not easily found; wide variation can be observed in the prices of nearly identical properties over short periods and still wider variations exist in the prices of properties which appear to be close substitutes. Appraisal is difficult in such cases; individual sales must be examined for less obvious differences and an average or typical price derived from those which survive close scrutiny.

Under what conditions will agricultural use value correspond with the "single" value established by the market? It is at least necessary that agriculture be the highest and best use for the land at the time of the sale. In cases where the land is ripe for more intensive uses, the price in exchange may exceed its value in agriculture. Where agriculture is still the highest use, the land will probably be purchased by active farmers; its price may reflect a premium for the best guess of the market participants as to the chances of an eventual transfer to a more intensive use.

Even if all questions of changing uses within a reasonable period of time can be eliminated, the market price is still not necessarily indicative of use value. Land also provides potential returns as an appreciating asset. Several writers would argue that this return is not part of agricultural use value; it is very much a part of the same speculation phenomenon, the effects of which the laws were instituted to counteract (Pasour, 1979). Market prices, however, probably reflect buyers' anticipation that land will continue to appreciate in the future. Thus, the price of farmland, even without the possibility for more intensive use, could still exceed that justified solely by its return in food production.

The comparability of sales can also be assumed only under some idealized set of market conditions. Sales must take place between "willing" buyers and sellers. Neither party can be subject to "unusual" influence or

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5/ A third method, known as "replacement cost less depreciation", is used in specialized applications but it is not relevant for land valuation.

necessity, nor can there be the possibility of large nonfinancial considerations due perhaps to transactions among relatives.[6/] The land must have physically similar soil productivity, topography, climate, farm size, past history of land management, and drainage and be comparable in terms of any governmental restrictions attached to it.

For these and other reasons, many sales of land must be eliminated from consideration. The data base for market comparisons in setting use values may be quite small and for those sales that provide valid comparisons, the most efficient farmers are likely to be the strongest bidders. It is their judgment which will decide the price. Some market participants may also have unusually large amounts of investment capital, as is the case where farmers who have sold farmland in urban fringe areas for development purposes are attempting to buy farms in nearby rural areas. These buyers may dominate the bidding and the sale price may not reflect the return most farmers could expect to earn from the land.

Investment tax credits and fluctuating product prices have also been partially responsible for what some have pointed to as "overcapitalization" in American agriculture (Robinson, 1975). For these reasons, farmers are frequently in search of additional land over which to spread any excess capital investment. Thus, it is conceivable that farmland prices would be higher in many instances than prices which would be justified by the income expectations of the average farmer.

In summary, where sufficient data exist, the major advantages of the market comparison approach have to do with its relative simplicity and conventional data requirements. In using them to set use values, the appraiser simply complements or substitutes for his own judgment the collective judgment of buyers and sellers. The other major alternative--income capitalization--requires greater familiarity with typical returns on assets of various types, as well as a general understanding of the nature of time preference.

The Capitalization of Income

Factors of production have value insofar as they contribute to output (income). When the factor is durable, as in the case of farmland, the income accrues over a period of years. Therefore, to estimate the value of a durable factor of production, all income accruing in future years must be discounted (capitalized) back to the present.

The Capitalization Procedure

To apply income-capitalization in estimating the value of land (V_j), one must estimate the useful years of life of the land resource (n), the net

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6/ One example of unusual influence might be the case of a farmer who is trying to enlarge his farm by purchasing adjoining land; such cases are encountered frequently; 59 percent of all farmland transfers over the 1971-75 period were of this type (USDA, 1975).

income potential of land in any year i during its productive life (A_i) and the rate at which incomes in a future year i should be discounted to reflect the true opportunity cost (c_i). Under these general conditions, the algebraic formula for calculating the value of an asset is given by

$$(5)\quad V_1 = \frac{A_1}{(1+c_1)} + \frac{A_2}{(1+c_1)(1+c_2)} + \frac{A_3}{(1+c_1)(1+c_2)(1+c_3)} + \ldots + \frac{A_{n-1}}{(1+c_1)\ldots(1+c_{n-1})} + \frac{A_n}{(1+c_1)\ldots(1+c_{n-1})(1+c_n)} .$$

Where income accrues in perpetuity and the discount rate is assumed the same each year, the asset's value is given by

$$(6)\quad V_2 = \sum_{i=1}^{\infty} \frac{A_i}{(1+c)^i} ;$$

if $A = A_i$ for all i (a constant yearly income stream), then it can be shown that equation (6) reduces to

$$(7)\quad V_3 = \frac{A}{c} .$$

This is the version most commonly encountered in empirical work. In reality, however, property taxes which are not explicitly accounted for in A_i, reduce the potential value of the property and future incomes are not constant. One cannot know precisely the implications of using equation (7) rather than equation (5) but an assessment of the differences can be made under special conditions.

If farmland is subject to the real property tax at a yearly rate of r per dollar of value (rV_4), the capitalization formula in equation (7) changes to reflect its reduced value

$$(8)\quad V_4 = \sum_{i=1}^{\infty} \frac{A}{(1+c)^i} - \sum_{i=1}^{\infty} \frac{rV_4}{(1+c)^i} ;$$

$$(9)\quad V_4 = \frac{A}{c} - \frac{rV_4}{c};$$

$$(10)\quad V_4 + \frac{rV_4}{c} = \frac{A}{c};$$

$$(11)\quad \frac{(c+r)V_4}{c} = \frac{A}{c}; \text{ and}$$

$$(12)\quad V_4 = \frac{A}{(c+r)} .$$

Two types of error in forecasting future income accruals were considered by Locken (1976, 1977). The first involves an income stream which is not constant but increases yearly by some constant dollar amount (D). The present capitalized (use) value, ignoring taxes for simplicity, is then the sum of two components:

$$(13)\quad V_5 = \sum_{i=1}^{\infty} \frac{A}{(1+c)^i} + \sum_{i=1}^{\infty} \frac{iD}{(1+c)^i},$$

which reduces to

$$(14)\quad V_5 = \frac{A}{c} + \frac{D(1+c)}{c^2}.$$

The expression, $\frac{D(1+c)}{c^2}$ is the error in estimating the value of an asset. Its effect on the present value of landowner's tax bill (for a constant tax rate) is

$$(15)\quad T_5 - T_3 = \sum_{i=0}^{\infty} \frac{rD(1+c)/c^2}{(1+c)^i}$$

$$(16)\quad = \frac{rD(1+c)}{c^2} \cdot \sum_{i=0}^{\infty} \frac{1}{(1+c)^i}$$

$$(17)\quad = \frac{rD(1+c)}{c^2}\,(1+c/c) \quad \underline{7/}$$

$$(18)\quad = \frac{rD(1+c)^2}{c^3}.$$

If the yearly income increase is a constant fraction (p) of income in the initial year, the present capitalized (use) value (tax not considered) may be written as:

$$(19)\quad V_6 = \sum_{i=1}^{\infty} \frac{A(1+p)^i}{(1+c)^i};$$

which reduces to

$$(20)\quad V_6 = \frac{A(1+p)}{c-p}. \quad \underline{8/}$$

7/ The sum of the infinite series $\sum_{i=0}^{\infty} \frac{1}{(1+c)^i}$ can be calculated as $\frac{1+c}{c}$, where $c > 0$.

8/ The sum of the infinite series $\sum_{i=0}^{\infty} \frac{A(1+p)^i}{(1+c)^i}$ can be calculated as $\frac{A(1+c)}{c-p}$ where A is a constant, $c > 0$, and $0 \leq |p| < c$.

The difference in value attributable to not predicting the percentage increase in yearly income is given by

$$(21)\quad V_6 - V_3 = [\frac{A(1+p)}{c-p}] - [\frac{A}{c}] = \frac{[A(1+p)(c)] - [A(c-p)]}{c(c-p)} = \frac{Ap(1+c)}{c(c-p)} .$$

The present value of the difference in taxes is

$$(22)\quad T_6 - T_3 = \sum_{i=0}^{\infty} r\frac{A[p(1+c)]}{c(c-p)} \cdot \frac{(1+p)^i}{(1+c)^i} = \frac{rA[p(1+c)]}{c(c-p)} \cdot \sum_{i=0}^{\infty} \frac{(1+p)^i}{(1+c)^i} = \frac{rAp(1+c)^2}{c(c-p)^2} .$$

Because equation (7) represents the most commonly used approach, it is also important to examine the impact on V_3 of changes in A or c. The elasticity of the capitalized value to changes in the capitalization rate may be computed as follows. From equation (7) one has

$$(23)\quad \frac{\partial V}{\partial c} = \frac{-A}{c^2} ,$$

and

$$(24)\quad \frac{\partial V}{\partial c} \cdot \frac{c}{V} = \frac{-A}{c^2} \cdot \frac{c}{V} = \frac{-A}{cV} = -1.$$

The elasticity of capitalized value to changes in yearly income (A) is

$$(25)\quad \frac{\partial V}{\partial A} \cdot \frac{A}{V} = \frac{1}{c} \cdot \frac{A}{V} = \frac{A}{cV} = 1.$$

Thus, a given percentage change in the capitalization rate leads to a change in the asset's value in the opposite direction but equal in relative magnitude. Similarly, a given percentage change in (A) results in the same percentage change in (V).

Despite equation (7)'s shortcomings, it is perhaps the only alternative for estimating agricultural use values that is administratively feasible for a state agency. One still needs to develop estimates of A and c.

The Capitalization Rate

In the context of land valuation, the capitalization rate c is a rate of return which adequately reflects the opportunity cost of owning land as compared with some other income earning asset. Because there is no universally accepted rule for specifying what constitutes a comparable investment to agricultural land, three general procedures for selecting a capitalization rate have emerged.

The summation method recognizes that a capitalization rate is composed of premiums for risk, liquidity characteristics and management requirements. For residential income property, for instance, the Federal Housing Administration (FHA yearly) decomposes the rate into components for "safety of principal," "certainty of return," "regularity of return," "liquidity," and "burden of management."

The band of investment method recognizes that most property acquisitions are financed by a combination of borrowed and equity capital. The capitalization rate is the sum of the individual rates, weighted by the respective percentages of equity and borrowed capital in the total price.

The third approach is simply to use the rate of return on some other investment or comparable property for capitalization purposes. Comparable investments may include other real property, financial investments such as bank deposits or bonds, or mortgages. Reynolds and Timmons (1969) have proposed that the relevant comparison in the case of farm real estate is investment in other farm capital. Still others argue that interest rates or rates of return on other farm investment are irrelevant to the determination of a suitable capitalization rate and that only market-determined rates of return on similar properties are relevant (Ferraro, 1967).

All these approaches rely heavily on subjective judgment. In attempting to choose among them, several points can be made. The summation method clarifies but does not solve the problem; it actually increases the number of values which must be chosen. The band of investment approach would be difficult administratively. Because the equity position of farmers varies widely, it would be impossible to obtain a single representative capitalization rate being sought for a class of property.

Although the method of comparison with alternative investments also contains arbitrary and subjective elements, it seems to place the most emphasis on the opportunity cost of comparable alternatives foregone as the essential ingredient in a capitalization rate. For those who are considering investing in farm real estate, the relevant opportunity cost may not be the rate of return on farm machinery nor other capital inputs as Reynolds and Timmons suggest (except possibly in the case of enlarging an existing farm) for investment of this type usually presupposes previous investment in farm real estate. It may also be difficult to view the going rate of return on other farms (yearly income divided by market value) as the relevant opportunity cost, although this has been proposed by writers who view the capitalization rate and the internal rate of return for a class of property as two different names for the same thing (Wendt, 1974). A farmer-investor must compare such an investment with other alternatives having similar risk and liquidity.

Unfortunately, financial assets for which information on rates of return is quite easily obtainable, are in many ways not comparable to farmland as investments. Land is a lumpy investment and the landowner generally must assume the entire burden of managing his assets. Land can also offer owners a hedge against inflation and land is much less liquid than are financial assets.

For these reasons, it is probably more logical to use rates of return on other real assets when constructing a capitalization rate specifically for land valuation. The most widely utilized members of this class are undoubtedly farm mortgage rates and rates of return on bonds and common stock. Kost (1969) found that rates of return on farm real estate were significantly below returns on common stock, but his analysis pertained to a period of relatively low inflation (1950-1963). Even though his results may not be applicable to later years of higher inflation, this criticism alone is not sufficient to rule out using the return on common stock. A more serious objection would seem to be the different degree of liquidity and management requirements which stocks have as compared to farmland.

Renne (1947) suggests that the farm mortgage rate should not be used to capitalize farm income except in cases where land values and farm income have been stable for some time or have been rising. For periods of uncertainty, he recommends the interest rate on land contracts as more suitable. A similar line of argument holds that farm mortgages are relatively low-risk investments and the mortgage rate is consequently a "safe" rate which does not adequately reflect the risks involved in farming.

In many states, use-value assessment laws actually specify the rate which is to be used for income capitalization, often tying it to a bond or mortgage rate. In California and Virginia, for instance, the rate is developed as a sum of separate components for interest, property taxes, and if applicable, risk and depreciation. The interest and tax components apply to all land; the former is determined in Virginia by averaging the interest rates on Federal Land Bank bonds for the five years used to determine average agricultural income, and the latter is the average effective tax rate during the same five years for the jurisdiction in which the land is located (Virginia State Land Evaluation Advisory Committee, 1977). The risk component is used only in cases where land is subject to seasonal wetness which cannot be remedied by tilling or drainage ditches, and the depreciation component is used only in the case of orchards where the differences in the economic lives of different types of fruit trees must be accounted for in assigning them use values. The California procedure is very similar, the major difference being that the yield on long-term government bonds as most recently published by the Federal Reserve Board is used as the interest rate.9/

Yearly Return to Land (A)

To apply equation (7), one must also estimate the yearly return to land. Three strategies for doing so are discussed.10/

Rental Income: One obvious strategy is to rely on market information, in this case information from the land rental market. The yearly rent for an acre of farmland, net of land maintenance costs borne by the owner, could be used as an estimate of its yearly return and capitalized appropriately.

9/ A 1980 amendment to New York's legislation required the use of a five-year average effective interest rate on new farm loans made by the Farm Credit Bank of Springfield, Massachusetts (Gardner and Conklin, 1980). The present study was too far underway at the time this legislation was passed to incorporate this interest rate. The interest rate (the yield on AA corporate bonds) which was utilized was very similar to the loan rate over the study period.

10/ The discussion in this section abstracts from the land quality issue, an issue which is examined in greater detail in the empirical sections to follow.

This strategy works well only if the market is active and has established a single, recognized price for land of a given quality. However, this appears not to be the case in New York. In his 1974 survey, in Columbia County, New York, Bryant (1975) noted the existence of many zero rents and little relationship between rental charges and the intensity with which the rented land was used. A more recent survey in New York also indicates a wide variation in rental charges (Knoblauch, 1980).

Several explanations may be offered for the existence of zero or nominal rates in areas where substantially higher rents can also be found. Competition for a given rental tract is likely to be limited to those farmers whose land adjoins it, or is nearby (Locken, 1976). Some landowners may charge low rents because they consider the appreciation on their land an adequate return, or the lessee may be providing other services such as fertilization, fencing or holding back the encroaching forest. Additional problems are created when share rents are used instead of cash rents.

Because there are good reasons to believe that an active cash rental market does not exist in New York, this study gives no further consideration of rental rates as a means of estimating yearly returns to land.

Residual Income (RI): The yearly return to land on a farm may also be calculated through an accounting process; costs of other factors are subtracted from gross farm receipts and any remaining value is attributed to land. Much of the information needed is available from farm business records.

According to economic theory, the value of the products of a profit maximizing firm in long-run competitive equilibrium is exactly equal to the total value of productive inputs. Algebraically, one can write

$$(26) \quad \sum_{i=1}^{n} Y_i R_i - \sum_{i=1}^{n} X_i P_i - C_L L = 0,$$

where:

Y_i = amount of ith product sold;

R_i = revenue per unit of Y_i;

X_i = amount of farm input i;

P_i = the price of imputed cost of X_i;

L = amount of land; and

C_L = cost per unit of land service.

If data on output and other input prices exist, then the returns to land can be estimated as a residual:

$$(27) \quad C_L L = RI = \sum_{i=1}^{n} Y_i R_i - \sum_{i=1}^{n} X_i P_i \ .$$

The residual income (RI) per acre can be determined by dividing this total residual income by the number of acres of land. One might reasonably expect some correlation between the per-acre residual income and the average quality of farmland on the farm but using total farm receipts and costs to estimate the residual return disguises the value of any particular parcel of land.

Agricultural values developed in this way are likely to be more variable over time than are market values and the approach is of little use in establishing a value for agricultural land not used for actual crop production.

The problems of year-to-year variability can be partially resolved by averaging the data for several years. The procedures can also be adapted to estimate the agricultural value of individual soils. Rather than applying equation (27) to total farm receipts and costs, one could use the yields, costs and returns and crop rotations for individual soils to derive directly the yearly returns to an acre of land of a given quality (Knoblauch, Milligan, Haslem and van Lieshout, 1980).

It has been argued that adapting the residual income method to individual soils abstracts from any problems in whole-farm analysis brought about by livestock enterprises and eliminates the possibility of attributing any of the value of the livestock enterprise to land. The proponents argue that any additional value added due to feeding crops to livestock is management and should in no way be attributed to the land resource.[11/] An important part of the study is to understand the implications of these alternatives.

Regardless of which adaptation of the residual income method is used, it implicitly assumes that all factors are rewarded according to their marginal productivities and that markets for all inputs exist and are in long-run competitive equilibrium. These assumptions may be reasonable for some factors, but for others, markets may not exist. Returns to these factors are assumed to be imputed in such a way as to satisfy this condition.

Some confusion also exists as to the appropriate charge for farm labor. Labor returns in American agriculture have traditionally lagged behind wages in other sectors because of the existence of disequilibrium and factor immobility in the agricultural sector (Tweeten, 1969). Therefore, one might question the validity of using a non-farm wage as an opportunity cost of labor. The relative efficiencies of unpaid family labor and hired labor are also difficult to determine.

There is less agreement on the contribution of management to farm production. Clark (1973) suggests that management might be properly accounted for by reducing the rate of return on land, calculated as the ratio of residual income to land price, by approximately one-third. Schofield (1965) has used a similar rule of thumb; he assumes returns to management of five

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11/ One problem with this interpretation is that in dairy farming regions, organized markets for the major forage crops may not exist. It is difficult to place a value on the output when most of the crops produced are eventually fed to livestock on the same farm.

percent of cash receipts. For dairy farms, buildings, livestock and machinery are major investment items. The problem of assigning to them an appropriate rate of return is similar to that of selecting a capitalization rate.

Because of the difficulties in identifying appropriate charges for some important inputs or outputs, it is useful to understand how sensitive residual income is to these components. This is best seen by looking at the elasticity of RI with respect to P_i, X_i and $\sum_{i=1}^{n} Y_i R_i$. These elasticities can be derived from equation (27). We know:

$$(28)\quad \frac{\partial RI}{\partial P_i} = -X_i; \quad \frac{\partial RI}{\partial X_i} = -P_i.$$

Therefore,

$$(29)\quad \frac{\partial RI}{\partial P_i} \cdot \frac{P_i}{RI} = \frac{-X_i P_i}{\sum_{i=1}^{n} Y_i R_i - \sum_{i=1}^{n} X_i P_i} \text{ ; and}$$

$$(30)\quad \frac{\partial RI}{\partial X_i} \cdot \frac{X_i}{RI} = \frac{-X_i P_i}{\sum_{i=1}^{n} Y_i R_i - \sum_{i=1}^{n} X_i P_i} .$$

Similarly, the percentage change in residual income attributable to a percentage change in farm receipts can be expressed as:

$$(31)\quad \frac{(\partial RI)(\sum_{i=1}^{n} Y_i R_i)}{(\partial \sum_{i=1}^{n} Y_i R_i)(RI)} = 1 \cdot \frac{\sum_{i=1}^{n} Y_i R_i}{\sum_{i=1}^{n} Y_i R_i - \sum_{i=1}^{n} X_i P_i} = \frac{\sum_{i=1}^{n} Y_i R_i}{\sum_{i=1}^{n} Y_i R_i - \sum_{i=1}^{n} X_i P_i} .$$

These elasticities express the changes which result in the residual income attributable to land when either gross farm income or the price or quantity of any input changes. They vary directly with the importance of an input or product in the revenue or cost situation.

Marginal Value Products (MVP): A third way to identify the yearly return attributable to land in agriculture is to estimate a production function for agriculture and calculate the MVP of land. As in the case of the residual return to land, the MVP of land can be derived for a whole farm or for the production of a single crop. If the latter strategy were used, the MVP for land of a particular quality would be the weighted average of the yearly returns to various crops, weighted by the crop's frequency in a rotation.

The whole-farm approach offers several advantages for New York agriculture. First, because much farmland is used in support of dairy production, problems of output aggregation for whole-farm analysis are minimized. Second, while the state is not likely to adopt a MVP-approach, because of its complexity, it is one additional attempt to apportion the value of output of dairy farms among capital, labor, land and livestock. It helps one understand the implications of assigning explicit returns to factors other than land in the residual returns procedures.

To determine the marginal value product of land, one must estimate a production function. This requires two major decisions (and a number of minor ones): the first is the choice of an appropriate algebraic form of the function; the second is the specification of input categories. The first problem is addressed in this section, while a discussion of the second is found in subsequent sections.

A number of algebraic forms of the production function have been used in empirical studies of agriculture (Heady and Dillon, 1961). Some have been used for specialized situations where specific technical relationships of production were being studied; the use of exponential and hyperbolic functions to estimate crop-fertilizer response is an example. In studies where whole-farm production functions have been estimated, the form which has been almost universally selected is the Cobb-Douglas function. Major reasons for its popularity include ease of estimation (it is linear in logarithms) and its tendency to fit the data well. In addition, research interest has generally focused on factor returns in agriculture and scale economies; the substitutability of factors in farm production has received less attention.

Initially, three algebraic forms of the production function were considered. The Cobb-Douglas (C-D) is given by

$$(32) \quad Y = \alpha x_1^{\beta_1} x_2^{\beta_2} \dots x_n^{\beta_n};$$

where Y = output;

x_i = input i; and

α, β_i = constants.

A second functional form, the Constant Elasticity of Substitution (CES) function has the C-D function as a special case (Arrow et al., 1961). One form of the CES function is given by Uzawa (1962) as

$$(33) \quad Y = \alpha_0 \left[\sum_{i=1}^{n} \gamma_i x_i^{-\rho} \right]^{-v/\rho};$$

where α_0, γ_i, v and ρ are parameters and Y and x_i are defined as above.

The third form, the translog function, also has the Cobb-Douglas function as a special case. It is specified as

$$(34) \quad Y = \beta_0 [\prod_{i=1}^{n} x_i^{\alpha_i}][\prod_{i=1}^{n} x_i^{1/2(\sum_{j=1}^{n} \beta_{ij} \ln x_j)}],$$

where β_0, α_i and β_{ij} are parameters. This function has been used widely by Christensen et al., 1970; Sargan, 1971; Humphrey and Moroney, 1975; Shih et al., 1977; and Vinod, 1972.

The choice of production functions must be based on both theoretical grounds (the ability to represent the underlying technical relationships) and the ease of statistical estimation. The technical relationships constitute an abstract technology (Brown, 1966) consisting of four parts: a) efficiency; b) input intensity; c) scale economies; and d) factor substitution.

Brown presents three general criteria which all production functions should satisfy (Brown, 1966, p. 29). An increase in each input should have a positive effect on output, and marginal products should decrease over some relevant range. Also, the degree of economies of scale should not be specified in advance by the production function. With the advent of more flexible forms of the production function and statistical techniques to estimate them, one could require that the substitutability between inputs not be given a priori as well.

Both the C-D and CES production functions are homogeneous and their properties are well documented in the literature (e.g., Ferguson, 1969, and Brown, 1966). They are only summarized briefly here. An interesting feature of the C-D production function, equation (32), is that the exponents, β_i, are the output elasticities of the x_i; their sum indicates the degree of homogeneity and the returns to scale. Marginal products are given by $\beta_i Y/x_i$. For marginal products to be positive, one must require $\beta_i > 0$, for all i. The constant term must also be positive; it provides a measure of the efficiency of technology. Technical change which does not alter input ratios ("neutral") is reflected in changes in the constant term (efficiency parameter). Non-neutral technological change is reflected by a change in the ratio of the β_i's.

Although Brown notes that the C-D function (with the parameter restrictions above) guarantees positive but decreasing marginal products and unrestricted returns to scale, some of its properties may be undesirable in certain applications. For example, all inputs must be at a positive level for output to be positive. The fact that the C-D function has a constant elasticity of substitution (for both the direct and Allen partial elasticity of substitution) equal to unity has limited its usefulness in some applications.

In contrast, Arrow et al. (1961) developed the Constant Elasticity of Substitution (CES) production function which allows for elasticities of substitution other than unity. A n-input generalization of their two-factor CES function is given in equation (33). Over the past twenty years, a number of other generalizations of the CES functions have also been developed and their properties have been discussed at length (Ferguson, 1969 and Brown, 1966). They have a number of desirable properties. For positive values of α_0; $0 < \gamma_i < 1$; $\sum_{i=1}^{n} \gamma_i = 1$; $\infty > \rho > -1$ and $v = 1$, the function is homogeneous of degree 1, yields diminishing marginal returns to all inputs and exhibits constantly declining marginal technical rates of input substitution. The Allen partial elasticity of substitution is given by:

$$\sigma_{ij(AES)} = \frac{1}{1+\rho} .$$

When $\rho \to 0$, $\sigma_{ij(AES)} = 1$, and equation (33) reduces to the C-D function; as $\rho \to \infty$, $\sigma_{ij(AES)} = 0$, and one has the fixed-coefficient production function.

Despite these desirable characteristics, the CES function has never been used extensively in empirical analysis. It is neither linear in the parameters nor is it linear in logarithms. Thus, a stochastic version of it cannot be estimated by ordinary least squares. Non-linear estimation procedures have been tried but convergence is slow. Therefore, non-linear estimates are both expensive to obtain and are still only approximations (Miller et al., 1975). Direct approximation of (33) by expanding (33) by Taylor's series around $\rho = 0$ has met with some success (Kmenta, 1967, and Griliches and Ringstad, 1971), but only in the case of two inputs. For more than two inputs, it is impossible to identify all the parameters (Boisvert, 1981). For these reasons, no further attention is given to the CES function.

A recent development in the search for more flexible functional forms has been the translog production function, first introduced by Christensen, Jorgenson and Lau, 1970. In algebraic form, it is represented by equation (34) but it is most often seen in its logarithmic transformation,

$$(35) \quad \ln Y = \ln \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln x_i + 1/2 \sum_{i=1}^{n} \sum_{j=1}^{n} \beta_{ij} \ln x_i \ln x_j .$$

It can be viewed in two different ways: as a production function in its own right; or as an approximation to some underlying, but unknown, production function.12/

As an exact production function, equation (35) reduces to a Cobb-Douglas function when $\beta_{ij} = 0$, all i,j. Thus, as in the case of the CES approximation, one has a direct test of the Cobb-Douglas form. When at least one $\beta_{ij} \neq 0$, the function may or may not be well-behaved. That is, a production

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12/ The two interpretations are discussed and their properties derived by Boisvert (1981) in an unpublished paper. The latter interpretation is possible through a second-order Taylor series expansion around some interesting point, e.g., the geometric mean values of the variables. Terms beyond the second order are ignored and the parameters of the function are interpreted as derivatives of the unknown function (i.e., the α_i are the first derivatives and the β_{ij} are second derivatives at the point of interest). If the data are scaled about the geometric mean, the estimated characteristics of the underlying technology (using either interpretation) are equivalent. This has practical implications for calculating elasticities of substitution.

function is usually considered to be well-behaved if output is a monotonically increasing function in all inputs and if the isoquants are convex. This function can exhibit variable returns to scale, is not necessarily homogeneous, and allows for variable elasticities of substitution.

To demonstrate these properties, it is convenient to begin with the production elasticities

$$(36)\quad e_i = \frac{\partial \ln y}{\partial \ln x_i} = \alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j \qquad (i=1,\ldots,n).$$

The marginal products become

$$(37)\quad \frac{\partial y}{\partial x_i} = [\frac{\partial \ln y}{\partial \ln x_i}]\ [y/x_i] = [\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j]\ [y/x_i].$$

For finite applications of x_i, the marginal product of x_i can be positive for a range in values of x_j but can be negative if $\beta_{ij} > 0$ (all i,j) and $x_j \to 0$. Similarly, if there exists at least one $\beta_{ij} < 0$, $\partial y/\partial x_i < 0$ as $x_j \to \infty$. Thus, because monotonicity requires that for all i, $\partial y/\partial x_i > 0$, the translog function is not well-behaved globally.

The second direct and cross partial derivatives are obtained by applying the chain rule to equation (37). For all i and j

$$(38)\quad \frac{\partial y^2}{\partial x_i^2} = y[\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j]\ [\frac{-1}{x_i^2}]$$

$$+ \frac{1}{x_i} \left[y(\beta_{ii}/x_i) + \frac{y}{x_i} [\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j]^2 \right]$$

$$= \frac{y}{x_i^2} \left[-(\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j) + \beta_{ii} + [\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j]^2 \right]$$

$$= \frac{y}{x_i^2} \left[\beta_{ii} + (\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j - 1)\ (\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j) \right]$$

and

$$(39)\quad \frac{\partial^2 y}{\partial x_i \partial x_j} = \frac{1}{x_i} \left[y(\beta_{ij})\frac{1}{x_j} + (\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j)(\alpha_j + \sum_{i=1}^{n} \beta_{ij} \ln x_i)\frac{y}{x_j} \right]$$

$$= \frac{y}{x_i x_j} \left[\beta_{ij} + (\alpha_i + \sum_{j=1}^{n} \beta_{ij} \ln x_j)(\alpha_j + \sum_{i=1}^{n} \beta_{ij} \ln x_i) \right] .$$

The isoquants are strictly quasi-convex if the Bordered Hessian matrix is negative definite (Henderson and Quandt, 1979). Because the values of the first and second partial derivatives vary with input levels, there is no guarantee that the isoquants are globally convex. However, in empirical research, "... there are regions in input space where these conditions are satisfied. If these conditions can be verified for each data point for any estimated translog function, the well-behaved region may be large enough to provide a good representation of the relevant production function" (Berndt and Christensen, 1973, p. 85).

Ferguson (1979) establishes that the "function coefficient" (the proportional change in output due to equal proportional changes in all inputs) is equal to the sum of the production elasticities for nonhomogeneous functions as well. The practical significance lies in the fact that for nonhomogeneous functions such as the translog function, the function coefficient is not invariant with initial input levels. From equation (33) the function coefficient (ε) is

$$(40) \quad \varepsilon = \sum_{i=1}^{n} \varepsilon_i = \sum_{i=1}^{n} \alpha_i + \sum_{i=1}^{n} \sum_{j=1}^{n} \beta_{ij} \ln x_j \ .$$

However, if one restricts the paremeters to

$$(41) \quad \sum_{i=1}^{n} \beta_{ij} = \sum_{j=1}^{n} \beta_{ij} = \sum_{i=1}^{n} \sum_{j=1}^{n} \beta_{ij} = 0,$$

the function is homogeneous and by also requiring that

$$(42) \quad \sum_{i=1}^{n} \alpha_i = 1,$$

the function is linear homogeneous (Boisvert, 1981; Humphrey and Moroney, 1975).

Sargan (1971) demonstrates that if the data are scaled around the geometric means, the direct elasticity of substitution in the translog case is given by 13/

13/ The use of a's and b's rather than α's and β's for the parameters of the log-quadratic function is deliberate. Boisvert (1981) has shown that there is a definite relationship between the estimated parameters (α_i, β_{ij}) of the scaled translog function (scaled about the geometric mean) and the estimated parameters of the function using unscaled data. The relationships are:

$$\beta_{ij} = b_{ij} \text{ for all i and j; and } a_i = \alpha_i + \sum_{j \neq i}^{n} \beta_{ij} \tilde{\ln} x_j + \beta_{ii} \tilde{\ln} x_i$$

where $\tilde{\ln} x_i$ is the geometric mean of the unscaled data. The practical significance of this is that the formula for the direct elasticity of substitution in the "unscaled" model is extremely cumbersome. However, because of the relationship among the parameters in the two models, equation (42) also gives the DES for the "unscaled" model evaluated at the geometric mean. It is used in this study only for computational purposes. This same relationship would hold at any point around which the data are scaled. Therefore, it follows that the DES is dependent on input levels.

$$(43)\quad \sigma_{ij(DES)} = -\frac{[a_i+a_j]}{-[a_i+a_j]+\left[\dfrac{a_i^2b_{jj}-2b_{ij}a_ia_j+b_{ii}a_j^2}{a_ia_j}\right]}\ .$$

Capitalized Income Estimates of Land Value from Farm Records for New York

Several estimates of agricultural use values for land in New York are derived in this section. They differ in that two strategies for estimating yearly returns to land are examined: a residual income approach based on costs and returns from the whole farm; and MVP's for land based on a whole-farm production function. (Yearly returns per acre of land in 8 soil classes based on partial enterprise budgets for hay and corn silage, the method implemented by SBEA in 1981, are developed and compared with these results in subsequent sections.)

Data Used in the Analysis

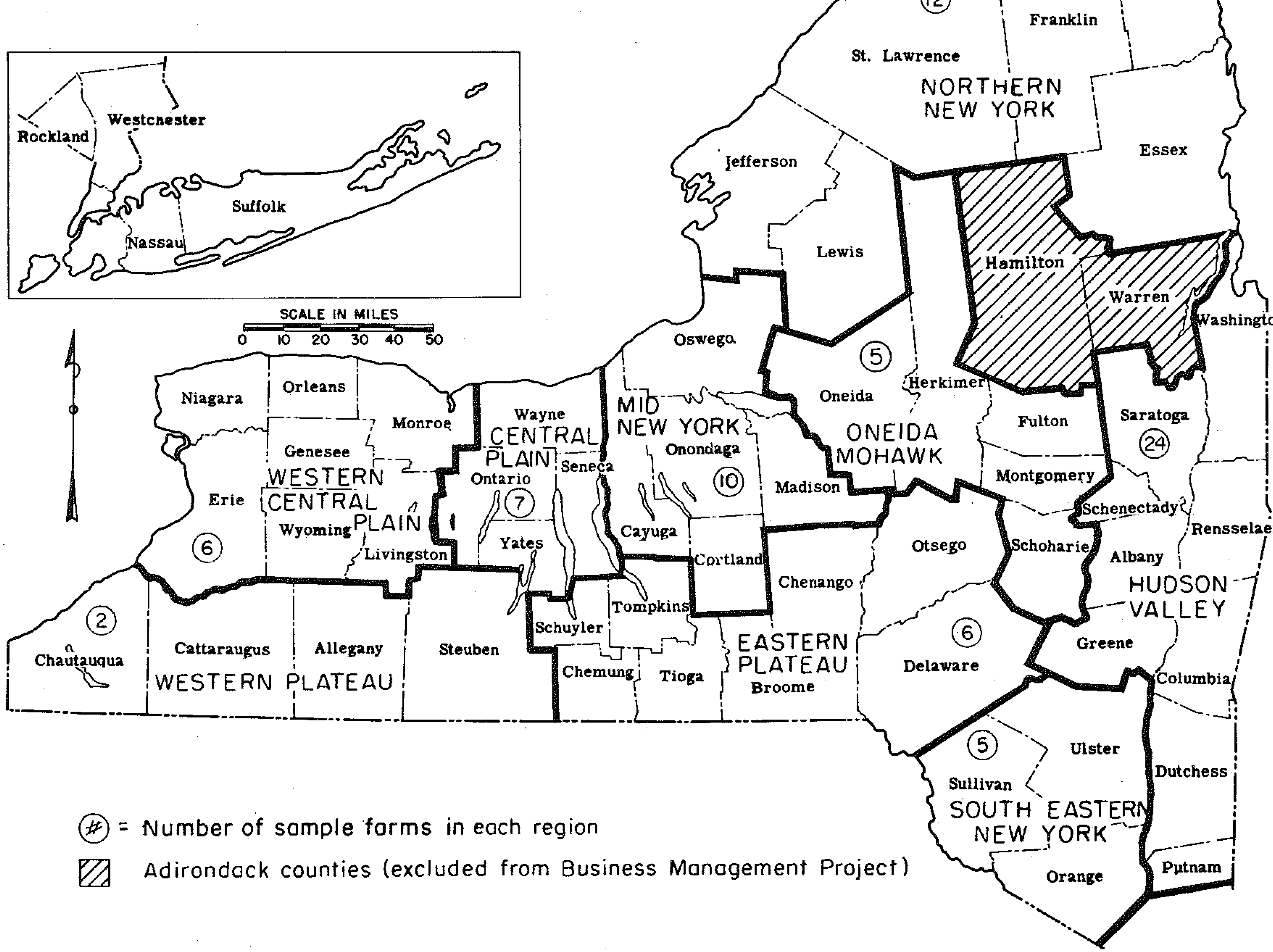
Dairy farming, the single most prevalent type of agriculture in New York was chosen as the focus of the present research and much of the analysis relies on cost and return data collected through the Cornell Dairy Farm Business Management Project. Extension personnel collect business records from farmers who participate voluntarily and the information is summarized on a state and regional basis by the Department of Agricultural Economics.

One major limitation of these data for the present research is that they do not contain information on the quality of soils. In 1976, however, 126 farmers were asked to locate their farms on soil maps as part of a special farm management study (Yates, 1977). These farms--called the "Farm Credit Panel"--had previously been selected "to provide complete physical and financial data for the 5-10 years following selection of the group, to determine financing and finance-related difficulties, and generate information to assist in dealing with some of these business problems" (Sutter et al., 1974, p. 2). All farms included had experienced or were experiencing growth. They were selected from the larger group of project farms through a stratified random sampling procedure according to herd size, and together represented 36 counties across the State.

Only a subset of these credit panel farms was selected for use in this study. A series of at least five years' financial data per farm was needed to reflect average economic conditions in dairy farming. Data were available for 77 farms over the period 1971 through 1975, the year for which soils information was available. It is not known if these farmers had applied for the agricultural use-value exemption in these early years.

The geographic distribution of the "sample farms" used in the study is in Figure 1; the regions for which the Cornell dairy farms records are summarized are superimposed. Although the credit panel farms were selected at random from the 500 to 700 farms cooperating in Cornell Dairy Farm Management

FIGURE I. REGIONS USED IN CORNELL DAIRY FARM BUSINESS MANAGEMENT PROJECT



(#) = Number of sample farms in each region

Adirondack counties (excluded from Business Management Project)

Project, it would be difficult to argue that the sample used here is representative of farms across the state. Bratton (1977) states, for example, that project farms "do NOT represent the 'average' for all dairy farms in the state," but goes on to say that they "do represent a good cross section of better than average commercial operators" (p. 1). These conclusions are substantiated by the data in Table 1.

Table 1. Characteristics of New York Dairy Farms, 1974

Farm Characteristic	Group Averages		
	Sample Farms a/	Project Farms b/	New York Farms c/
Machinery and Equipment Investment	$ 51,523	$ 41,153	$ 36,053
Land and Building Investment	$148,066	$122,074	$132,211
Crop Acres	287	213	200
Number of Milk Cows	95	72	51
Total Cash Receipts	$123,136	$ 86,604	$ 49,679
Pounds Milk Sold	1,249,160	905,800	n.a. d/
Land and Building Investment/Cow	$ 1,715	$ 1,695	$ 2,592
Machinery and Equipment Investment/Cow	$ 575	$ 572	$ 707
Crop Acres/Man Equivalent	98	89	n.a.
Cows/Man Equivalent	33	30	n.a.
Pounds Milk/Man Equivalent	423,640	374,300	n.a.
Number of Farms in Group	77	596	

a/ Sample of farms from the Cornell Dairy Farm Management Project used in this study (unpublished data).

b/ All farms in the Cornell Dairy Farm Management Project (Bratton, 1975).

c/ Farms having yearly gross sales of at least $2,500 (U.S. Bureau of Census, 1977).

d/ Not available.

The average commercial dairy farm in New York in 1974 had fewer cows and a lower level of machinery and equipment investment than the average farm in Cornell's management project; the number of crop acres was only slightly lower. "Project" farms were also operated more intensively; the group averaged about three acres in crops per cow compared with an average of four acres per cow statewide. "Project" farms also had significantly lower average fixed investment (land, buildings, machinery) per cow than other dairy farms across the state.

The major differences between the project farms and the 77 sample farms are size and labor efficiency. On average, the sample group has 35 percent more acres of cropland and 32 percent more cows. Investments in both machinery and real estate per cow and per crop acre are nearly identical for the two groups. Both groups also have approximately the same number of crop acres per cow. Labor efficiency, as measured by either cows or pounds of milk per man equivalent is slightly higher for the sample farms. Average milk production per cow is over 550 pounds higher in the sample farms as well. A sample of this type, however, can offer several advantages in conducting the research, even though recent amendments to the legislation specify that capitalized incomes be based on average conditions. From an agronomic viewpoint, better management is easier to define analytically because soil productivity can be assumed to be based on optimal application of fertilizer, lime, erosion, control practices, etc. Therefore, one possible approach to estimating use values is to assume improved management and adjust it downward to reflect less than optimal management conditions. Such an adjustment might be made through negotiation in the political arena or through comparison of financial records from farms under various levels of management. Maximum attainable use values also may be appropriate if increased efficiency of resource use is desirable. This policy would reinforce the penalty for underutilization already built into the property tax (Barlowe, 1978, p. 621); but would protect farmland against taxes attributable to development potential.

Soil Quality on the Sample Farms

In order to estimate whole-farm residual returns and MVP's per acre and adjust for land quality, a soils index was developed. Several factors, many beyond the control of the researcher, have frustrated attempts to measure land productivity accurately. Some work has been conducted, such as Seay's (1960) experimentally obtained yield estimates for a limited number of soil mapping units in the Allegheny Plateau region of New York, but this type of information is not available for most of the soils in the state. However, beginning in the early 1900's, soil surveys have been carried out in New York counties by the U.S. Department of Agriculture. In 1931, the first New York Soil Survey to contain productivity ratings, reflecting the generally observed conditions in the county, was published for Steuben County. The earliest soil surveys presented productivity information as an index according to which soil mapping units in a county were ranked, the best one receiving a value of 100. "Productivity" levels which could be maintained without the aid of artificial fertilizer were assumed (Seay, 1960). Around 1950, the Soil Conservation Service (SCS) began publishing actual yield figures as well. The notion of inherent productivity was phased out at the same time, and separate yields for two management levels--"average" and "improved"--were given. Still, the yield information was the result of informed judgment as to the conditions prevailing under each type of management.

Another way in which SCS provides information on land quality is through the Soil Capability Classification scheme, designed primarily to highlight the need on some soils for erosion-prevention and drainage practices (Olson, 1974). Because of its emphasis on erodibility, major discrepancies can exist between soil quality as measured by soil capability classes and by actual yields. An otherwise highly productive soil phase of moderate slope is relegated to a lower-quality capability class than the same soil in its level phase, even though identical yields are possible on these soils with improved management.

The diversity of crops raised in New York also handicaps efforts to measure land quality. Because dairy farmers commonly raise corn, hay and sometimes one or more small grains, a corn/soybean suitability rating that might be applicable for the midwest cannot be used in New York. In addition to the yields for each crop, rotations must be considered.

Scientists at Cornell University have used a productivity index which takes account of these factors in rating soils for several New York counties where up-to-date yield information is available.14/ This index is constructed on the basis of the Total Digestible Nutrients (TDN) produced on an acre of soil. TDN is calculated for each soil mapping unit in the county by: weighting the yield for each crop (hay or corn silage) by the percentage of the total years in the crop rotation cycle during which it is grown; weighting the resulting calculation for each of the two crops by a TDN conversion factor for that crop; and summing the results. The most productive soil in the county is given an index of 1.00.

Although this index has a number of desirable properties, current yield information on which it is based was not available for most New York counties in the summer of 1980, the time at which much of this study was completed. Due to the lack of information, a decision was made to develop an index which could be applied on a statewide basis and which made use of the existing productivity information contained in county soil surveys of varying vintage.15/ The method used for constructing this index is outlined in Table 2. Each soil mapping unit is given a rank (on a scale of zero to 1.00) in the

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14/ See Agronomy Mimeos: 78-15 (Cayuga); 78-17 (Cortland); 77-24 (Genesee); 78-13 (Jefferson); 77-32 (Ontario and Yates); 78-16 (Orange); 77-19 (Schuyler); and 77-18 (Ulster), Department of Agronomy, Cornell University, various dates.

15/ Subsequent analysis based on unpublished data has led to the adoption of such an index for 1981 use-value assessment purposes. To the extent possible, the two indexes are compared in subsequent sections of the report.

production of hay, corn silage or oats, the crops generally grown in forage rotations. These ranks are available directly in soil surveys published in the 1931-1950 period. To calculate ranks for soil mapping units in counties with post-1950 surveys, the yields given for all mapping units were divided by those given for the most productive mapping unit, thus producing a set of ranks on a scale of zero to 1.00. In both cases, the productivity data obtained from soil surveys pertained to improved crop management; this management level was selected in order to be as consistent as possible with the generally high level of management on the sample farms.

Table 2. Calculations of a Soil Quality Index 1 and Adjusted Crop Acres ("n" soils per sample farm)

	Yield Rank[a/]		Incidence in Rotation[b/]		Crop Index
	Corn Silage Rank	x	fraction corn	=	$\text{Index}_{(\text{corn silage})}$
(Soil i)	Hay Rank	x	fraction hay	=	$\text{Index}_{(\text{hay})}$
	Oats Rank	x	fraction oats	=	$\text{Index}_{(\text{oats})}$

$$\text{Soil Quality Index}_{(\text{soil } i)} = \text{Index}_{(\text{corn silage})i} + \text{Index}_{(\text{hay})i} + \text{Index}_{(\text{oats})i}$$

$$\text{Adjusted Acres}_{(\text{soil } i)} = \text{Total Crop Acres}_{(\text{soil } i)} \times \text{Soil Quality Index}_{(\text{soil } i)}$$

$$\text{Total Adjusted Crop Acres} = \sum_{i=1}^{n} \text{Adjusted Acres}_{(\text{soil } i)}$$

a/ Yield ranks, on a scale of zero to 1.00, are either given in soil surveys (1930-1940) or calculated by dividing the actual yield for each crop (given in post-1940 soil surveys) by that of the most productive soil in the county. In counties having pre-1930 soil surveys (Chautauqua, Chenango, Clinton, Columbia, Delaware, Erie, Madison, Montgomery, Oneida, Saratoga, St. Lawrence), ranks were developed from soil surveys of contiguous or similar counties.

b/ Rotations were those which farmers in the sample actually used.

Once a rank was available for each soil mapping unit on the sample farms for each of the forage crops grown, it was possible to create an overall soil quality index by weighting each individual crop index according to the incidence of that crop in the rotation. Rotations selected were those average rotations as calculated from the crop acreage figures in the farm records. They are not necessarily the rotations recommended by SCS.

In order to use the county-level soil information of different vintages so as to construct a statewide index, two assumptions were necessary.[16/]

16/ Dr. Richard W. Arnold, formerly of the Department of Agronomy, Cornell University, judged these assumptions to be reasonable.

First, because of the diversity of New York soils, all counties with significant agricultural areas have at least some of the highest quality soils, it seemed reasonable to assume that the best soil in each county was of similar quality. Second, it was assumed that although the absolute yield figures for the various soils have changed over the years, the relative ranks have not. This ignores the possibility that technical change and some new crop and forage varieties may have favored some soil types more than others, but information to make any necessary adjustments is not available.

To construct a land quality index for each of the 77 sample farms, one further assumption was necessary. Because the farm management information compiled at Cornell does not relate crops to specific soil types, it was assumed that the best soils on a given farm were the ones cropped. This, of course, is not strictly accurate. However, one might expect that this assumption would consistently overestimate productivity on all farms, thus having a minimal impact on much of the econometric estimation reported later.

This approach to measuring land quality is not without limitations. The SCS productivity information on which it is based is ultimately the result of informed judgment by soil scientists, but this is true also of all comprehensive indexes. Hay, oats, and corn are also weighted equally in the index although they differ in the relationship of nutritional value to production. Had yield data been available in soil surveys for all counties, the nutritional value of hay, oats and corn in terms of TDN or other common units could have been incorporated into the index. As it stands, the only weighting of the three crops is due to the incidence in rotations.

The method has several advantages. It utilizes a continuous ranking procedure which avoids the need to place soils into a small number of arbitrary classes. The "acres" concept is retained to meet the theoretical requirements for data used to estimate production functions. It provides a summary measure of cropland quality by farm, the ratio of adjusted acres to crop acres. This ratio ranged from 0.45 to 1.0 for the sample farms with a mean of 0.76 and a standard deviation of 0.12.

Used in conjunction with the residual income and MVP calculations employed in this study, soil index 1 and the concept of quality-adjusted acres provide a means of accounting for land quality differences among the farms.

Residual Income Estimation

Residual income attributable to land is calculated for each farm in each year by means of the residual income equation (27). For this particular application,

$$(44)\quad C_L L = \sum_{i=1}^{m} Y_i R_i - P_1 X_1 - X_2 - P_3 X_3 - P_4 X_4 - X_5 - X_6,$$

where:

L = total cropland area measured in acres or adjusted acres;

C_L = residual income per acre or per adjusted acre;

Y_i = number of units sold of farm product i;

R_i = price per unit of farm product i;

X_1 = total non-land capital investment;

P_1 = interest charge per dollar of non-land capital;

X_2 = selected expenses, including depreciation;

X_3 = months of operator labor;

P_3 = monthly charge for operator labor;

X_4 = months of unpaid labor;

P_4 = monthly charge for unpaid labor;

X_5 = hired labor expense; and

X_6 = estimated interest payments on working capital.

Interest payments on working capital--not available directly from the data--were estimated as:

(45) X_6 = total interest paid $- [(X_1 - C_1X_1) \cdot P_1]$,

where

C_1 = the proportion of owner equity in total farm investment.[17/]

The yearly averages of the variables used in the residual income equation are given in Table 3. Most of them were available directly from the data collected for the Cornell Dairy Farm Business Management Project. Total farm receipts include the total value of sales and milk, livestock, crops, and other farm income such as payments for custom work and off-farm labor, government payments, and the gasoline tax refund. The non-land capital investment category is the sum of the end-of-year inventories of livestock, machinery, feed, supplies and farm buildings. Investment in farm buildings was not available; it was set at 36 percent of total real estate investment, the state average for dairy farms (USDA-ERS, 1977). The rate of return on AA industrial bonds is used to estimate a return to capital; it averaged 8.4 percent between 1971 and 1975.

Expenses for hired labor were available, but outside information was needed in developing charges for operator labor and unpaid family labor.

17/ Data on interest paid and owner equity were not available for all farms in all years. Where these variables were available, the interest paid on working capital was estimated and deducted as an expense item. Where unavailable, all capital was assumed to be investment capital and X_6 was set equal to zero. When the calculated value of $[(X_1-C_1X_1) \cdot P_1]$ was larger than total interest paid, X_6 was also set to zero.

Table 3. Average Values of Variables Used in Residual Income Estimation, 77 Sample Farms

Item	Year				
	1971	1972	1973	1974	1975
Total Farm Receipts	$ 88,994	$ 94,193	$119,577	$134,125	$134,372
Total Non-land Capital Investment	$132,621	$151,942	$184,010	$200,525	$214,868
Yield on AA Industrial Bonds[a/]	0.0794	0.0763	0.0780	0.0903	0.0957
Selected Expenses[b/]	$ 45,039	$ 45,957	$ 60,962	$ 73,874	$ 76,739
Months of Operator Labor	15.27	15.27	15.12	14.94	14.79
Value of Operator Labor/Month[c/]	$ 731	$ 762	$ 924	$ 997	$ 970
Months of Unpaid Labor	2.19	2.05	1.97	1.64	1.56
Value of Unpaid Labor/Month	$ 490	$ 537	$ 655	$ 722	$ 681
Months of Hired Labor	17.65	17.51	17.37	17.16	16.99
Hired Labor Expense	$ 7,519	$ 8,764	$ 9,975	$ 11,177	$ 12,219
Percent Owner Equity	n.a.	n.a.	72	73	74
Interest Paid	n.a.	n.a.	$ 5,315	$ 5,922	$ 7,119
Crop Acres	251	243	269	287	292
Adjusted Crop Acres	192	187	206	217	220

a/ This interest rate is used as a charge for investment capital and for purposes of capitalizing land income (Moody's Investors' Service, Inc. 1978, p. a36).

b/ Expenses for property taxes, insurance, rent, livestock purchase, and interest on borrowed capital are excluded.

c/ Statements by operators as to the opportunity cost of their labor were available for all farms in 1975 only. The 1975 figures were deflated for the other years according to a price index for agricultural management labor (1975=1.000, 1974=1.028, 1973=0.952, 1972=0.786, 1971=0.754) which was calculated as the ratio of the 1975 wage for agricultural managers in New York to that for each of the 4 preceding years. Unpaid labor was charged at the average per month wage rate received by agricultural laborers in New York (USDA Statistical Reporting Service, 1972-76).

In 1975, each operator made an estimate of the income that could be earned in alternative employment during that year. These figures were used in constructing a charge for the number of months of operator labor for 1975, and they were deflated by an index of changes in the average wage of farm managers in New York during the previous four years (USDA-ERS, 1972-76). Months of unpaid family labor were charged at the average monthly wage rate for agricultural laborers (USDA-ERS, 1972-76).

Expenses for property taxes, insurance, rent, livestock purchases and interest paid on borrowed investment capital were omitted. Property tax payments were excluded because they are incorporated into the capitalization rate, insurance is a "non-productive" expense and rent is part of the return to land which the equation seeks to isolate. Livestock purchases represent a capital investment which is charged already at the rate of return on industrial bonds.

Equation (44) yields estimates of the total residual income attributable to the land on each farm in each year. To obtain a per-acre estimate, the total residual income is divided by the number of crop acres. Dividing by the number of adjusted crop acres gives an estimate which pertains to this standardized unit of land. The residual income is capitalized, using equation (12), to estimate use value. The capitalization rate is the sum of the yield per dollar on AA industrial bonds and the average effective real property tax rate per dollar of market value for each of the five years (1971-75) in the counties in which the sample farms were located (New York State Comptroller, 1972-76).

Estimates of the average residual and capitalized returns to land for the sample farms are in Table 4. The residual incomes per crop acre range from \$32 in 1975 to \$72 in 1973 and the five-year average is \$50. The "adjusted" crop acreage on each farm is the acreage of the most productive farmland required to equal the productive potential of the farm's actual cropland, recognizing that it is of different quality. Therefore, the residual income per adjusted crop acre can be interpreted as the value of an acre of cropland of the highest quality. As the productivity index of land declines, the return to land is assumed to decline in the same proportion. Thus, the ratio of the return per acre and the return per adjusted acre reflects the average quality of cropland in each year. This is also true for the capitalized values--the agricultural use values. These ranged from a high of \$815 per adjusted acre in 1973 to a low of \$346 in 1975, the average over the study period is \$550.

These values exhibit the same general trend over the five-year period as farm income in New York (Table 1). Although gross farm incomes continued to rise throughout the five-year period, costs increased by enough that in 1972, 1974 and 1975 residual values of land fell from the preceding year. There was also great variability among the residual incomes calculated for the sample farms in any given year (Table 5). This variability, particularly the negative values on some farms, underscores the need for financial data from many farms in estimating use values through residual incomes to land. Moreover, yearly fluctuations in farm income cause volatility in use values if data for a single year are used.

Table 4. Residual Land Income and Use Values, New York Sample Farms

Year	Average Residual Income[a/] Per Crop Acre	Average Residual Income[a/] Per Adjusted Acre[c/]	Capitalization Rate[b/] Interest Component	Capitalization Rate[b/] Tax Component	Average Capitalized Land Value Per Crop Acre	Average Capitalized Land Value Per Adjusted Acre[c/]
1971	$50	$66	0.0794	0.0391	$425	$553
1972	43	57	0.0763	0.0408	369	486
1973	72	95	0.0780	0.0386	616	815
1974	53	73	0.0903	0.0377	418	569
1975	32	45	0.0957	0.0338	245	346
1971-75	50	67	0.0839	0.0380	411	550

a/ Average of the per-acre residual land income for each of the 77 farms, not weighted by farm acreage and rounded to the nearest dollar.

b/ Residual incomes are capitalized using equation (12). The interest component of the capitalization rate is taken from Moody's Investors' Service Inc., 1978 and the tax component is from data from the New York State Comptroller, 1972-76. Had the recommendation in the 1980 amendments to the Agricultural Districts Law been followed, the interest component for the 5-year period would have averaged 8.22 percent (Farm Credit Bank of Springfield, 1971-75). This is the average interest rate on new farm loans for New York by the bank.

c/ See Table 2 for a definition of adjusted acres.

Table 5. Variation in Residual Income per Adjusted Crop Acre for the Sample Farms

Residual Income	1971	1972	1973	1974	1975
Mean Value[a/]	$ 66	$ 57	$ 95	$ 73	$ 45
Maximum Value	279	355	353	380	270
Minimum Value	-81	-90	-63	-238	-168
Standard Deviation[a/]	71	68	92	98	76
Number of Negative Values	13	11	8	11	20

a/ Rounded to nearest dollar.

The sensitivity of this residual income (RI) to changes in expenditures on capital, labor, or variable costs, or to changes in total farm receipts can be analyzed by means of the elasticities in Table 6. A one percent change in variable expenses (non-labor) has a greater effect on residual income than a one percent change in either prices or quantities of capital or labor employed. Similarly, percentage changes in the charge for operator labor have a relatively greater effect than the same percentage changes in the charge for hired or unpaid labor. These results are particularly significant in employing residual incomes in estimating use values. The prices and quantities of two of the inputs, capital and operator labor, to which the residual returns are most sensitive are also the most difficult to estimate. Underestimates of returns to either capital or operator labor would lead to serious overestimates of the residual returns or the capitlaized values.

Table 6. Elasticities of Residual Income to Change in Input Prices, Input Quantities, and Total Farm Receipts

	Elasticities a/					
	1971	1972	1973	1974	1975	Average (1971-75) b/
Operator Labor c/	-0.82	-0.77	-0.73	-1.00	-1.52	-0.97
Hired Labor c/	-0.55	-0.58	-0.52	-0.75	-1.29	-0.74
Unpaid Labor c/	-0.08	-0.07	-0.07	-0.08	-0.11	-0.08
Capital c/	-0.77	-0.77	-0.75	-1.22	-2.18	-1.14
Variable Expenses c/	-3.30	-3.03	-3.20	-4.96	-8.13	-4.52
Total Farm Receipts d/	6.51	6.22	6.28	9.00	14.23	8.45

a/ Calculated with average values of the variables for all 77 farms for each of the years.

b/ Simple average of yearly elasticities.

c/ From equation (29).

d/ From equation (31).

The same financial and physical information used to estimate the use value of land on the sample farms by means of the residual income method may also be used to obtain an alternative estimate which is based on marginal productivity. This alternative has been used in land valuation for research purposes but seldom, if ever, for tax purposes. However, it employs statistical techniques in an attempt to estimate simultaneously the portion of total product due to different inputs. In doing so, it abstracts from the problems of estimating in an ad hoc fashion the return to inputs which are not purchased directly or for which no markets exist.

Estimation of Marginal Products

To determine the marginal productivity of land, a variety of stochastic specifications of the Cobb-Douglas and translog production functions (equations (32) and (35) respectively), were estimated. Alternative specifications of the various inputs were considered. The time-series, cross section data were pooled using ordinary least squares, as well as covariance models with fixed effects for years, individual farms and agricultural regions. Because the problems of multi-collinearity are exacerbated in the translog case, considerable experimentation with subsets of the data was conducted to determine the potential effects of these problems on the stability of the estimated coefficients. A detailed discussion of the empirical estimation is given by Dunne, 1981; only the results of the model used in the final analysis are reported here.

Two alternative sets of input categories were examined in estimating production functions. The difference between these two variations involved the level of aggregation of the capital and expense variables; in the 4-input model two categories of capital investment are combined as are two categories of expenses. The various input categories for both models are described in Table 7.

As in all production analyses, the measurement of capital was difficult. Some would argue that service flows are the appropriate measure. Others would argue that because the stock is committed to the firm regardless of whether or not it is being used, it is the appropriate measure (Mount, 1970). Yotopoulous (1967) has shown that capital stocks are an acceptable proxy for service flows only under the very restrictive assumption that these two measures are proportional, i.e., that capital inputs are homogeneous, with respect to age and durability, and yield constant annual service flows. Even if this assumption were satisfied, stocks yield results equivalent to flows only when the production function being estimated is multiplicative, in which case the constant term absorbs the proportionality and the coefficients of the variables are unaffected. Two major problems were encountered in the search for a flow measure. The stock of capital in farm buildings had to be approximated from the farmers' estimates of the value of land and buildings; and the depreciation figures for machinery in the data provided an unreliable estimate of the amount of the stock used up in a given year.18/ Thus, it was not possible to compute an acceptable measure of service flows and the traditional stock measure was adopted for livestock, buildings, and machinery inputs.

18/ The data did not include separate values for buildings, so their value was estimated through use of the state average percentage which buildings were of total real estate investment. Machinery depreciation was calculated in the data as the difference between a year's beginning inventory (plus purchases) and the end inventory (plus sales), where the inventory figures were farmers' estimates of value. Thus, the available depreciation figures did not relate directly to the amounts of the inputs used each year.

Table 7. Variables Used in Production Functions

Variable	Explanation
Total Farm Receipts (dependent variable)	Sum of cash receipts and changes in inventories of livestock, feed and supplies
Livestock Investment[a]	End of year inventory value
Other Capital Investment[a]	Sum of end of year inventory values of machinery and building investment[b]
Labor	(Months of operator labor) + (months of hired labor) (.75) + (months of unpaid labor)(.50)[c]
Feed Expense[a]	Expenditure on concentrates and other purchased animal feed
Other Expenses[a]	Sum of all selected expense categories except "hired labor expenses"[d]
Land: Crop Acres or Adjusted Crop Acres	Separate equations, where all other input categories remain the same, are estimated for each of two land variables. "Crop acres" is total acres in forage crops, and "adjusted crop acres" is the same variable adjusted for soil productivity as described in Table 2.

a/ Each pair of capital and expense categories is aggregated to form the 4-input model described here, see Dunne (1981) for the 6-input model. All investment figures are estimates made by farmers.

b/ Building investment is estimated as 36 percent of total real estate investment (the state average for dairy farms during the years 1971-1975). See USDA-ERS, 1977.

c/ The treatment of hired and unpaid labor represents an attempt to maintain consistent labor quality in this aggregate variable. The weighting procedure is similar to that used by Griliches (1963, p. 423).

d/ Hired labor is in the "labor" category. Selected expenses also exclude rent, insurance, property taxes, and interest paid on borrowed capital.

The high correlations between variables also influenced the selection of input categories. The correlation between "number of cows" and "other expenses" in the present sample was 0.90, for instance, and the correlation between the same livestock variable and "labor" was 0.87. When "livestock investment" was used as a substitute for "number of cows," these correlations were reduced significantly. A further advantage of the latter treatment is that it may provide a method of taking variability in the quality of dairy cows into account, if it is assumed that quality is reflected in market value.[19]

19/ Quality variations are accounted for only insofar as the sample farmers could estimate accurately the value of livestock investment.

Enough information on labor usage was contained in the data to make possible its measurement in physical units. The various types of labor were weighted differently in constructing a total labor variable (see Table 7). The stock-flow problem for labor is essentially ignored; it is assumed that all available labor is actually used on the farms. The expense categories include selected variable costs associated with dairy farming, as described in relation to the residual income equation, with hired labor charges now excluded also. They are essentially flows as measured, because inputs of this type are either used up in a single year or added to total farm receipts (the dependent variable) in the form of positive inventory changes.

Land is measured both in crop acres and quality-adjusted crop acres in alternative specifications of the production function. It is assumed that the contribution of non-crop acres (35 percent of total acreage on average for the sample farms) to farm production is zero. The number of adjusted acres under crops for any farm in each of the five years is calculated according to the procedure outlined in Table 2.

Because of the nature of the translog production function, the problems with multi-collinearity between the dependent variables, including squared and cross-product terms, are substantial, particularly for the estimated 6-input model. To reduce the number of terms in the equations, the two investment and the two expense categories were aggregated into single inputs. This amounts to assuming that the sub-categories of such an aggregate variable are perfect substitutes, and that their output elasticities are the same (Griliches, 1957, p. 16). From the estimated parameters of the 6-input model (Dunne, 1981) it is clear that this is not the case; the return on livestock investment is considerably greater than the return on other capital and the returns per dollar of feed and other expenses are not equal. However, the 4-input model provides a means for examining the sensitivity of the estimated return to land to changes in the specification of the variables. The simpler model caused no problems in this regard, and the smaller model is preferred in that the number of highly collinear terms is reduced. Moreover, the investment and expense categories in the 6-input model are also aggregates of inputs which are less than perfect substitutes; the question of aggregation is therefore one of degree only.

When pooling time series and cross section data, the error terms across observations may also be correlated, in which case the Ordinary Least Squares (OLS) estimators no longer have the minimum variance property; they are still unbiased (Maddala, 1971). The loss of efficiency is greatest for smaller sample sizes, for OLS estimates of the coefficients will asymptotically converge on the "true" values when the sample size is infinitely large.

The situation may be viewed in two different ways; each implies a different solution to the estimation problem. One alternative is to view the part of the error term which is related to the time period or the cross-section as essentially fixed for all observations. This is known as the "fixed-effects" covariance model, in which the two separate effects are captured as the parameters of dummy variables which are included as part of the estimation method generally referred to as Least Squares with Dummy

Variables (LSDV). The time-series and cross-section effects could be viewed as random for different observations, "specific ignorance" as compared to the "general ignorance" represented by the ordinary error term (Maddala, 1977, p. 328). In this case, both the OLS and LSDV estimators are inappropriate; Generalized Least Squares (GLS) estimators are preferred.

Choice of an estimation technique depends on the nature of the problem. If a large sample is used, OLS may be adequate. The GLS method is most appropriate in the majority of situations, unless problems such as autocorrelation or heteroscedasticity are encountered in which case the computations necessary to overcome them would be burdensome. LSDV may be appropriate for whole-farm production functions. Mundlak (1961) has argued that farm-specific errors absorb the effect of management if it is not explicitly included as an input. When several years' data for each farm are used, it is reasonable to consider the management input as having the same effect throughout, i.e, the effect is not random but fixed. The error due to managerial variations is also likely to be correlated with some input categories and as such, cannot be viewed as random (Shih, et al., 1977). Thus, the LSDV estimation method is used. The final specification of the production function is a restricted form of the translog production function in which the coefficients on the squared terms are assumed to be zero. The model groups farm inputs into four categories. Regional dummy variables were included for both regions and time.

For this model (Table 8), all the regional dummy variables except one have t-values near or exceeding two, indicating that the intercepts for six of the seven remaining regions are different from the intercept for Southeastern New York. The coefficients on dummy variables for 1971, 1973 and 1974 have t-ratios above two, indicating that the intercept for these years is different from the intercept for 1975. The dummy variables were also important as a group (e.g. the computed statistic $F_{(11,363)} = 3.049$). The performance of the rest of the model was quite disappointing; the t-ratios are low. On the basis of these results alone, it is difficult to have much confidence in the marginal products of land derived in this way. However, by eliminating the cross-product terms and estimating the Cobb-Douglas analogue to the function in Table 8, the statistical properties improve considerably and the average MVP of land falls by less than 10 percent.[20]

20/ Boisvert (1981) shows that if the data are scaled about the means prior to estimating the translog model, the a_i's from equation become the production elasticities and are equal to the production elasticities (equation 36) when the unscaled model is evaluated at the geometric means. Since the t-ratios on these coefficients (a_i's from equation (43) for the scaled model) are all much greater than two (Dunne, 1981, p. 372) one also has some confidence in the reliability of the production elasticites and the MVP's at the geometric means for the unscaled model. The correspondence, unfortunately, holds only at this one point.

Table 8. Estimated 4-Input, Restricted Translog Production Function, 77 Sample New York Dairy Farms, 1971-75

Input Variables	Parameter Estimates	Dummy Variables For Regions and Years	Parameter Estimates
Capital (X_1)	-0.604 (-1.511)	Plateau	0.076 (1.966)
Expenses (X_2)	0.158 (0.284)	Oneida-Mohawk	0.107 (2.546)
Labor (X_3)	1.846 (2.253)	Western Central Plain	0.085 (2.027)
Adjusted Acres (X_5)	-0.251 (-0.467)	Central Plain	0.101 (2.425)
(X_1X_2)	0.078 (1.322)	Mid-New York	0.106 (2.544)
(X_1X_3)	-0.058 (-0.517)	Hudson Valley	0.030 (0.058)
(X_1X_5)	0.037 (0.495)	Northern New York	0.058 (1.698)
(X_2X_3)	-0.104 (-1.262)	1971	0.057 (2.375)
(X_2X_5)	-0.016 (-0.238)	1972	0.019 (0.819)
(X_3X_5)	0.012 (0.161)	1973	0.080 (3.722)
Constant	6.483 (1.954)	1974	0.044 (2.084)

R^2 = 0.9612

Durbin-Watson Statistic = 2.082

Sum of Squared Residuals = 6.082

Output Elasticity = 1.063

Note: The dependent variable is total farm receipts. The inputs are defined in Table 7; the regions are defined in Figure 1. The model is a LSDV model estimated by OLS. Numbers in parentheses are t-values.

The other Cobb-Douglas and translog specifications with the regional dummies produced average statewide MVP's for land quite close to the RI estimates (Dunne, 1981, pp. 218 and 242). While these models also performed better from a statistical perspective, little would be gained from a detailed analysis of them because of the similarity to the RI results. Furthermore, using the results from the equation in Table 8, provides a means for estimates for the MVP's of land between the extreme values generated from the various models estimated.

For the production function in Table 8, the MVP's for land and other factors of production are given in Table 9.[21/] They vary across all regions.[22/] The MVP per dollar of capital ranges from a high of $0.20 in the mid-New York region to a low of $0.09 in Southeastern New York. The extremes for the MVP per dollar variable expenses occur in the same two regions while the MVP per month of labor is the highest in the Northern New York region ($549). The item of major interest, the MVP per adjusted acre of land, ranges from a high of $49.58 in the Hudson Valley, to a low of $29.32 in Northern New York. The five-year average across all regions is $38.96.

From the standpoint of estimating use values, a production function of this kind is quite useful. Because the land input is defined in terms of quality adjusted acres, it makes possible the estimation of a use value for any dairy farmland if its relative soil quality is known. Based on the MVP's, the average capitalized value of an acre of the highest quality dairy farmland in New York over the years 1971-75 is approximately $319 (using an average capitalization rate of 12.2 percent). This figure is in sharp contrast with the $550 figure obtained using the residual income method (Table 4). Some understanding of the reasons for this large difference may be gained by examining the manner in which factor services were charged in the residual income equation in light of the MVP results.

In using the residual income approach, capital services were valued by applying the yield on corporate bonds, which averaged 8.39 percent between 1971 and 1975, to the stock of capital. In addition, depreciation charges were deducted for machinery and real estate improvements; if this depreciation is expressed as a percentage of total capital investment, it amounts to a further 4.9 percent of the capital stock deducted as a yearly provision for recapture of investment. Thus, capital services have been charged at (an average of) 13.29 percent of total non-land capital investment on the sample farms. However, the MVP of capital (Table 9) is 17 cents per dollar invested. If the MVP results are assumed to be a more accurate reflection of the resource's value in use, then capital charges have been too low in residual income calculations, and the resulting use value for farmland is too high.

21/ Second-order conditions for regularity of the production function were checked at the geometic means and were found to be satisfied. They have not been checked at other points.

22/ In addition to these regional differences in MVP's of the various factors of production, the translog specification of the production function allows for variable elasticities of substitution between pairs of inputs. The direct elasticities of substitution (DES) were calculated using equation (43), where the parameters of the function in Table 8 were reestimated using data scaled about geometric means. These results are in Dunne (1981) and the estimates are identical to the DES's for the unscaled function evaluated at the geometric mean. The DES for each input pair is: labor-land, -0.88; labor-capital, -1.52; labor-expense, -1.37; land-capital, -0.80; land-expenses, -1.05; and capital-expenses, -0.85.

Table 9. Marginal Value Products of Inputs on 77 Sample Dairy Farms in New York, 1971-75 Averages

Region	Input[a/]			
	Capital	Expenses	Labor	Adjusted Acres
Plateau	$0.18	$1.42	$359.87	$35.58
Oneida-Mohawk	0.18	1.51	352.06	35.13
Western Central Plain	0.18	1.52	413.67	33.92
Mid-New York	0.20	1.71	264.04	40.68
Central Plain	0.14	1.77	511.12	31.90
Hudson Valley	0.18	1.37	247.48	49.58
Northern New York	0.13	1.44	548.78	29.32
Southeastern New York	0.09	1.35	527.72	33.40
Average (all regions)[b/]	$0.17	$1.49	$373.84	$38.96

a/ These marginal value products (MVP) are estimated from the production function in Table 8 and equation (37). Because output is measured in dollars, marginal products are equal to marginal value products. MVP's are calculated for each region and each time period and averaged over the five years. Regional geometric means of the variables were used in calculating MVP's and estimates were made at the predicted level of regional output at these input levels. The five-year averages of the geometric means of the variables are given in Table 10. Variables are defined in Table 7.

b/ In computing an average across all regions, the regional estimates were weighted according to the proportion of all farms in a given region. Regions are defined in Figure 1.

A similar situation exists with respect to the variable expenses input. Each dollar of variable costs was subtracted from total income in the residual income calculations. In contrast, the statewide average MVP of a dollar spent in variable costs was $1.49 (Table 9), indicating that there is a significantly large contribution to production in excess of their cost on the part of purchased inputs of a non-durable nature. Again, residual income to land is overstated if this contribution is ignored.

On the other hand, the MVP results suggest that the charge for labor may have been too high in the residual income calculations. The MVP of operator, hired, and unpaid labor was approximately $374, $280, and $187 per month, respectively, if the weights used to adjust for quality differences between the three kinds of labor (Table 7) are applied to the MVP of operator labor. Based on these charges, the cost per month of average labor (total labor expenditure divided by total months of labor) would be $316. However, charges for labor services in the residual income calculations were significantly higher, averaging $709 per month. Although this

Table 10. Regional Geometric Means of Variables Used in Estimating the Production Function for 77 New York Dairy Farms (1971-1975 Averages)

Region	Gross Farm Receipts	Labor (months)	Adjusted Crop Acres	Capital Investment	Expenses
Plateau	$ 98,538	26.17	189.03	$131,373	$45,179
Oneida-Mohawk	100,780	32.65	198.18	123,229	44,223
Western Central Plain	102,263	23.06	198.89	139,888	45,506
Mid-New York	148,672	31.35	303.88	206,261	62,137
Central Plain	90,075	23.84	205.77	136,080	37,771
Hudson Valley	100,148	32.17	168.53	159,245	57,734
Northern New York	56,247	18.95	95.15	80,162	26,139
Southeastern New York	45,798	16.79	72.31	84,965	22,029

Note: Regions are in Figure 1 and variables are defined in Table 7.

comparatively higher charge for labor partially offsets the relatively lower charges for capital and expenses, the effect of lower net deductions than factor MVP's is an upward influence on residual land income and therefore on use value as estimated with the residual income approach. The non-comparability of these two methods of land valuation is highlighted if the input charges suggested by the MVP model are used in residual income calculations. The capital charge, for instance, would increase by 3.5 percentage points (16.8 percent as implied by MVP vs. 13.3 percent). Non-labor variable expenses are now deducted at an additional 49 cents per dollar ($1.49 vs. $1.00) and the per month labor deduction decreases by $393 ($709 - $316 = $393). The corresponding change in residual income per adjusted crop acre can be estimated by applying these charge differentials to the sample averages of the input categories as given in Table 3. Residual income per adjusted crop acre would decrease by $29.54 and $144.46, respectively, if the charges for capital and expenses are adjusted in this manner. On the other hand, it would increase by $66.06 as a result of the adjustment to the labor charge. The net effect of these three changes would be a decrease of $107.94. Thus, the estimated residual income of $67 per adjusted crop acre (Table 4) would obviously fall below zero. The true situation falls somewhere between the two extremes and the result would vary by farm and by region.

The major implication of these results is that the usual, market-determined input charges used in conjunction with the residual income method may not always reflect the true contributions of these inputs in agricultural production. Even so, one cannot conclude that this constitutes an overwhelming limitation in application of the residual income method. It suggests only that caution should be exercised in developing input charges. As in the case of the market sales approach, market information relating to input charges should be carefully reviewed and modified if necessary before it is used in calculating use values.

Comparative Analysis of Alternative Agricultural Use-Value Estimates in New York

Based on the residual returns to land and the marginal value products of land developed in the previous section, one can proceed with a comparison of four alternative procedures for estimating use values of agricultural land in New York. These four alternatives are: 1) capitalized marginal value product; 2) capitalized whole-farm residual incomes; 3) the market value approach; and 4) capitalized residual returns based on corn and hay enterprise budgets.[23/] Before this can be accomplished effectively, however, it is useful to compare soil quality on the sample farms as measured by two soil indexes.

Soil Quality on Sample Farms

Two separate measures of soil quality for cropland on the sample farms are represented in Table 11. Soil quality as measured by index 1 refers to the productivity index described in Table 2. This index is used in the MVP analysis and in the whole-farm residual returns calculated above. Index 2 was developed by Reid for the New York State Department of Agriculture and Markets. This index was designed specifically to provide individual soil

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23/ For purposes of identification, these four estimates of use value are labeled:

Alternative 1 (MVP)	=	MVP-based estimates from farm records.
Alternative 2 (RI)	=	Estimates based on whole-farm residual returns from farm records.
Alternative 3 (SEA)	=	Sales-based estimates. See Appendix 1 for associated land classes.
Alternative 4 (EB)	=	Estimates based on enterprise budgets. See Appendix 2 for a summary of the methodology.

Alternative (3) is the procedure used by SBEA prior to 1981 and is described by McCord, 1978; alternative (4) is the procedure implemented by SBEA in 1981 and is described by Dunne and Lynk, 1981. For purposes of this analysis, the enterprise budgets on which the new procedures are based were recalculated for 1971-75. The revised budgets are calculated by modifying the estimates in Knoblauch and Milligan, 1981, utilizing a number of price indexes. Input requirements and yields are assumed to be the same. In actual application, this procedure lags the tax year by 2 years (e.g., 1975-79, budgets used in obtaining 1981 values). However, in this study, 1971-75 budgets are used to obtain 1975 values to maintain comparability with alternatives (1) and (2). To reflect this 2-year lag, these 1971-75 averages for alternatives 1, 2 and 4 are compared with 1977 sales-based values for alternative 3.

Table 11. Soil Quality for Cropland on 77 Sample New York Dairy Farms, 1971-75 Averages

Region	Soil Quality as Measured by[a/]			
	Index 1[b/]		Index 2[c/]	
	Value	Rank[d/]	Value	Rank[d/]
Plateau	0.76 (0.55-0.87)[d/]	5	0.71 (0.50-0.71)	2
Oneida-Mohawk	0.83 (0.72-0.96)	3	0.70 (0.54-0.92)	3
Western Central Plain	0.74 (0.63-0.84)	6	0.64 (0.47-0.77)	6
Mid-New York	0.84 (0.64-0.95)	2	0.70 (0.29-0.84)	4
Central Plain	0.81 (0.72-0.87)	4	0.66 (0.45-0.76)	5
Hudson Valley	0.70 (0.45-0.94)	7	0.63 (0.39-0.87)	8
Northern New York	0.69 (0.55-0.87)	8	0.64 (0.40-0.84)	7
Southeastern New York	0.85 (0.68-1.00)	1	0.80 (0.75-0.95)	1
Average[e/] (all farms)	0.75 (0.45-1.00)		0.67 (0.29-0.95)	

a/ All indexes can range from zero to unity. For each farm i, year t and index j, the cropland soil quality is given by

$$SQ_{it}^{j} = \sum_k I_k^j A_{kit} \Big/ \sum_k A_{kit};$$

where I_k^j is the rank of cropland k according to index j and A_{kit} is the acres of cropland k on farm i in year t. Figures in the table are simple five-year averages for each farm in a region, averaged again across all farms in the region. Numbers in parentheses are the ranges across farms in the region.

b/ See Table 2 and Dunne, 1981 for details.

c/ From unpublished data developed by W. S. Reid, Department of Agronomy, Cornell University.

d/ Regions ranked from high to low by soil index.

e/ See Figure 1 for regions.

productivity rankings for use in New York's agricultural value assessment program. It was not available at the time this study was initiated and index 1 was developed.[24]

Because there were different amounts of land cropped in each year on each farm, each of the soil productivity indexes was calculated for each farm in each year. The productivity value assigned to each individual soil differed under each index. Generally, index 2 produced the lowest value. Index 1 produces an average value across farms of 0.75, while the average for index 2 is 0.67. The variability in the productivity across farms, as measured by the range, is higher for index 2.

While these differences would certainly affect the valuation of individual soils, the relative rankings of soil quality on farms by the two indexes are most critical for estimation purposes. On a regional and whole-farm basis, these rankings are quite similar. The simple correlation coefficient between the 5-year average of adjusted crop acres (all farms) as measured by index 1 and index 2 is 0.98. Thus, although the absolute values of the indexes differ for a given soil, the high correlation among adjusted acres implies that the relative magnitudes on a whole-farm basis are quite similar and the results of the statistical analysis reported above are insensitive to the particular index used. It is possible to argue that the results below are not seriously affected by use of index 1, but the theoretical and empirical basis for index 2 is clearly preferable if the data required to calculate it are available.

Regional Estimates of Agricultural Use Values

Having completed a discussion of the sample farms and soil quality based on the two indexes, one may compare the two alternative estimates of use value generated in this study with the values based on sales data and the estimates derived from corn and hay enterprise budgets. A logical place to begin is with a summary of the regional use-value estimates per adjusted crop acre based alternatives 1 and 2, MVP's and whole-farm residual incomes (Table 12).

The regional MVP estimates are based on equaion (34), which includes zero-one variables for both regions and time. Regional geometric means of the variables (including the predicted value of output) are used in the calculations to insure that differences in farm size among regions are taken

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24/ For this latter index (e.g., I_k), the index for soil k is based on production of Total Digestible Nutrients (TDN) and is calculated as

$$I_k = TDN_k / TDN_{k*}$$

where k* = soil with maximum TDN potential;

$$TDN_k = Y_{ck} \; T_c \; P_{ck} + Y_{Hk} \; T_H \; P_{Hk}$$

P_{ck} (P_{Hk}) = proportion corn (hay) in rotation on soil k;

Y_{ck} (Y_{Hk}) = tons corn silage (hay)/acre of soil k;

T_c (T_H) = TDN/ton corn silage (hay).

Table 12. Regional Annual Returns and Agricultural Use Values from 77 New York State Dairy Farms, 1971-75 Averages

Region	Annual Returns/Adjusted Crop Acre[a/]		Capitalization Rate[d/]	Use Value/Adjusted Crop Acre	
	MVP[b/]	RI[c/]		MVP[e/]	RI[e/]
Plateau	$35.58	$83.25	0.120	$296.50	$693.75
Oneida-Mohawk	35.13	71.12	0.122	287.95	582.95
Western Central Plain	33.92	79.40	0.119	285.04	667.23
Mid-New York	40.68	88.26	0.123	330.73	717.56
Central Plain	31.90	42.20	0.118	270.34	357.63
Hudson Valley	49.58	73.64	0.121	409.75	608.60
Northern New York	29.32	50.50	0.122	240.33	413.93
Southeastern New York	33.40	19.96	0.122	273.77	163.61
Average (all farms)[f/]	$38.96	$67.03	0.122	$319.34	$549.88

a/ Adjusted crop acres are the sum of total crop acres in each soil type multiplied by the soil index 1. (See Tables 2 and 11).

b/ Estimates based on marginal value products from Tables 8, 9 and 10 and equation (37).

c/ Estimates based on residual returns from sample farm data applied to equation (44).

d/ Computed as the average yield on AA corporate bonds between 1971 and 1975, plus the regional property tax rate per dollar of market value. (See Table 4).

e/ Corresponding annual return capitalized using equation (12).

f/ Estimates are simple averages for farms in each region. See Figure 1 for definition of regions.

into account. To capitalize the regional MVP estimates, the property tax component of the capitalization rate was adjusted for regional differences in the tax per dollar of full value.

The estimates of use value of an acre of the highest quality cropland in New York during the 1971-75 period ranges between $410 (Hudson Valley) and $240 (Northern New York), a difference of more than 40 percent. For the remaining six regions, the estimated use values are relatively similar--in the $270-$330 range; the average across all regions is $319.

Higher milk prices, combined with relatively large farm size and intensity (2.6 crop acres per cow vs. the state average of 2.9), seem to contribute to the high use value of land in the Hudson Valley. At the other extreme, Northern New York's handicaps in the form of adverse climatic conditions and extreme distance from the metropolitan New York City milk market contribute to the low use value of land in that region. The relatively low use value for Central Plain farmland at first seems questionable, but is perhaps partly explained by the fact that over 15 percent of the gross receipts of farms in this region were in the form of crop sales, whereas crop sales accounted for less than 4 percent of total receipts for the sample as a whole. The per-acre net returns from the cash grain crops grown on the farms in the Central Plain (corn grain, and wheat) were significantly lower than the returns from forage crops grown during the same period (Knoblauch and Milligan, 1977).

From Table 12, it is also obvious that the regional use values based on whole-farm residual incomes are generally higher than the MVP's estimates. The average use value is $550, about $230 higher than the MVP-based estimate. The differences among certain regions is also larger, more than 400 percent between Mid-New York and Southeastern New York. In addition, these differences are not easily explained by the regional differences in the agricultural industry. For example, the use value of land based on residual income in a prosperous agricultural region--the Central Plain--is lower than the use value of land in a considerably less prosperous one, Northern New York. The large difference in use value (almost 100 percent) between Central Plain and Western Central Plain farms is also a suspicious result, as dairy farming conditions in these two regions are quite similar.

As stated above, these difficulties are due in large part to the whole-farm residual income methodology itself, although when both are compared to estimating MVP's, the residual incomes seem to be sensitive to the financial position of the individual farms and valuation of resources. While the MVP's are based on a covariance analysis of all 77 farms, the valuation problems in the whole-farm residual returns are exacerbated by the small sample size in some of the regions. The variation in residual returns to land among the farms studied was large, with some farms having negative residual returns in one or more years and other farms having extremely large positive returns. Extreme care would be required if such a procedure were to form the basis for agricultural value assessment in New York. These results underscore the importance of a large sample and attempts to smooth year-to-year fluctuations.

To complete the discussion of the regional estimates of agricultural use values, the MVP- and RI-based alternatives must be compared with the sales and enterprise-budget based estimates (alternatives 3 and 4). This comparison is complicated by the fact that alternatives 3 and 4 assign soils to different groups based on ranges in productivity. Land in each of these groups is given a particular value, whereas, the use values of land in alternatives 1 and 2 are assumed to be continuous linear functions of productivity.

In order to make these comparisons one must translate SBEA cropland quality classes into the soil rating schemes based on both index 1 and index 2 (Table 11).25/ These SBEA classes, as applied to dairy farms, rate cropland according to its yield capability for the commonly-grown forage crops (corn silage, corn grain, hay, and small grains). Class "A" cropland is rated as being "capable of yielding over 100 bushels of corn, 3 1/2 tons of alfalfa, and 50 bushels of wheat per acre. Although a yield figure for corn silage is not given, a yield of over 20 tons per acre is consistent with the stated yields for other crops. Class "B" soils are defined as those yielding over 15 tons of corn silage and over 2 tons of hay, and Class "C" soils are those which yield less than 15 tons of corn silage and less than 2 tons of hay per acre or are suitable for pasture only.

The best soils in New York are capable of yielding about 24 tons of corn silage per acre (Soil Conservation Service, 1973). Soils which yield between 20 and 24 tons (SBEA Class A) would correspond approximately to those having productivity indexes from 0.83 to 1.00 ($20 \div 24 = 0.833$). Similarly, soils yielding between 15 and 20 tons (SBEA Class B) would rank between 0.63 and 0.82, and the remainder (SBEA Class C) would rank less than 0.62. For classes A and B, which have upper and lower boundaries, the midpoint of each range (0.915, 0.725) may be used in calculating single, representative use values. For purposes of estimating the average quality of Class C land, it was assumed that the lowest index for a soil used in agriculture is 0.25--the lowest rank for any cropland in the sample farms; the midpoint of the Class C range is therefore 0.44. To obtain use values estimated by alternatives 1 and 2 which correspond approximately to SBEA land classes A, B, and C, one may simply multiply the figures in Table 12 by 0.915, 0.725 and 0.44, respectively. Because the soil groups associated with index 2 are defined on the basis of ranges in productivity and not yields, it was necessary to make the correspondence between SBEA soil classes and the new Department of Agriculture and Markets soil groups on a slightly different but comparable basis (Appendix 2).

The alternative use-value estimates are summarized in Table 13. The MVP and RI based estimates are derived from the sample farms in each region. Regional SEA estimates are derived by averaging values across each county in a given region, while a single set of EB-based estimates is applied to all regions, to be consistent with current implementation of the law in New York. Percentage differences between alternative estimates are summarized in Figure 2.

Perhaps the most striking result of this analysis is the range in the alternative estimates of agricultural use value within each land quality class. Based on state averages, estimates of the value of cropland A range

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25/ SBEA quality classes for cropland are described in Appendix 1.

Table 13. Alternative Estimates of Market and Use Value of Agricultural Land in New York for the 1977 Tax Year

	Use Value per Acre									Market Value per Acre b/
	"A" a/ Cropland			"B" Cropland			"C" Cropland			
	SEA	MVP c/	RI	SEA	MVP	RI	SEA	MVP	RI	
Plateau	$327	$271	$635	$183	$215	$503	$ 98	$130	$305	$ 355
Oneida-Mohawk	298	263	533	180	209	423	96	127	256	359
Western Central Plain	374	261	611	231	207	484	127	125	294	359
Mid-New York	328	303	657	208	240	520	110	145	316	345
Central Plain	338	247	327	220	196	259	110	119	157	435
Hudson Valley	328	375	557	209	297	441	124	180	268	727
Northern New York	222	220	379	152	174	300	78	106	182	234
Southeastern New York	443	250	150	327	198	119	183	120	72	1,215
Average (all regions) d/	338	292	503	213	232	399	116	141	242	537
EB e/			(642)			(289)			(92)	

a/ The actual county use values (1977 average) established by SBEA based on market sales were grouped according to the regions used in this study in order to compute average regional values. Definitions for SBEA land classes A, B, and C are given in Appendix 1.

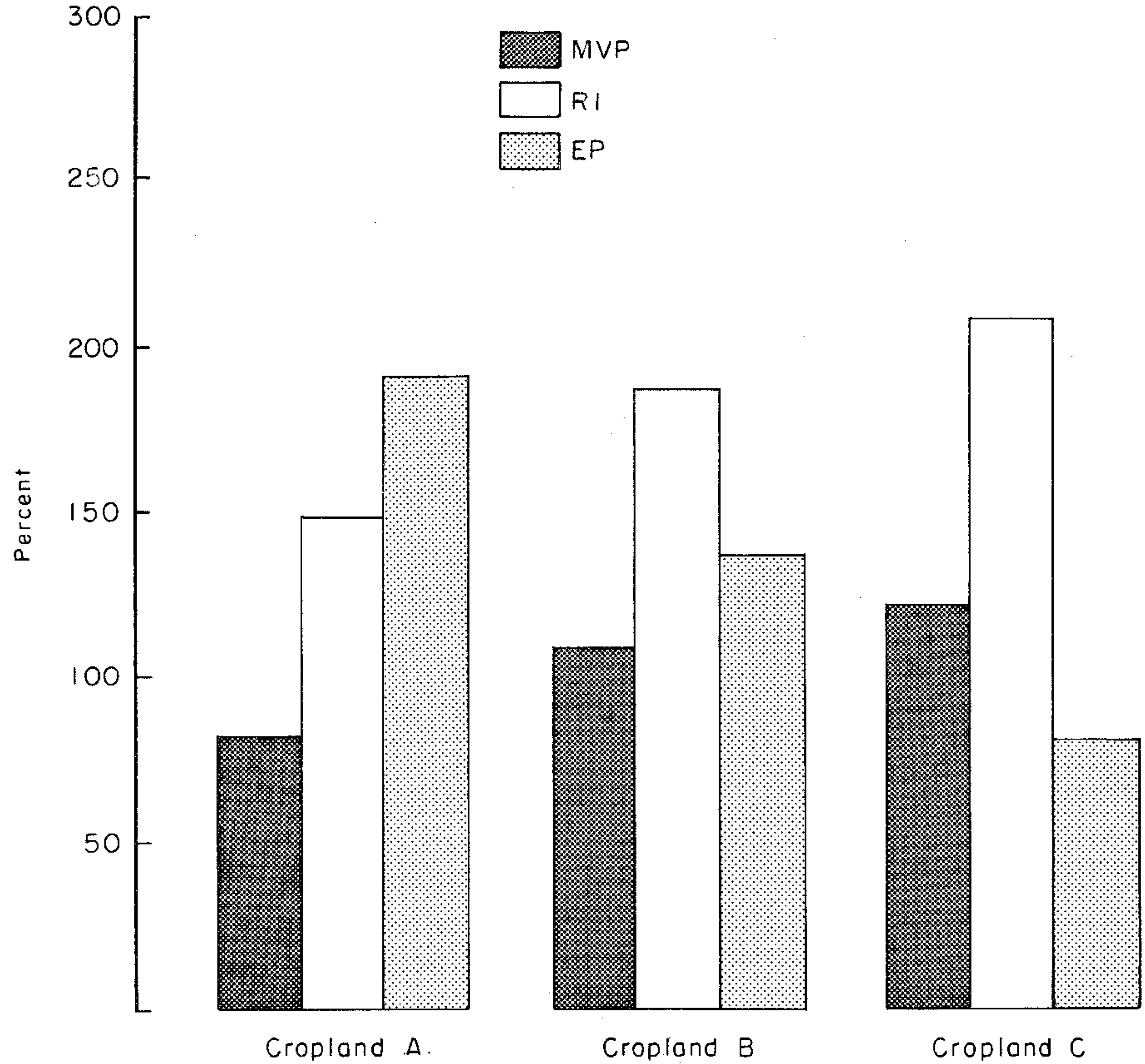
b/ Market value estimates are from a survey carried out by SBEA in 1974, inflated by the state average increase in index of farm real estate value between 1974 and 1977 (McCord, 1978 and USDA, 1977). The value of real estate improvements is deducted from farm sale prices at the state average value (36% of total farm value, USDA, 1977).

c/ MVP-based values are calculated from the regionalized version of the production function and are based, as are the RI estimates, on the entire 1971-75 data series. See the text for the productivity index assumptions.

d/ See Figure 1 for definitions of regions.

e/ These numbers in parentheses are use values based on capitalized residual incomes from corn and hay enterprise budgets (EB). The methodology is described in Knoblauch and Milligan (1981). For purposes of this study, adjustments were made in their costs and returns to reflect 1971-75 conditions. See Appendix 2 for more details and the procedure for matching new soil groups to A, B, and C land classes.

FIGURE 2. PERCENT CAPITALIZED AGRICULTURAL VALUES ARE OF SEA VALUES BASED ON MARKET SALES, NEW YORK



Source: Table 15

from a high of $642 to a low of $292 per acre. Cropland B's values range from a high of $399 to a low of $213 per acre, while for cropland C, the high estimate is $242 and the low estimate is $92 per acre. In two of the three classes, the 1975 SEA estimates are the lowest. For class A, the highest value is obtained using the EB estimate. For the other two classes, the RI alternative yields the high estimate. The class C estimates are almost identical under SEA and EB alternatives. With the exception of Southeastern New York, these same patterns hold for all Cornell Farm Management Project regions.

As suggested earlier, each of these methods of estimating agricultural use values has some theoretical basis and all but the MVP approach have been implemented in one form or another around the country. Thus, there is no completely objective criteria on which to select the "best" valuation method. From a farmer's perspective, for example, one might argue that the SEA procedure is preferred because its values are consistently lower than the others for all soil classes. However, this may not be true over time. Without also knowing more about the importance of farm property in individual jurisdictions, the effects of any methods on tax rates and ultimate shifts in tax burdens among classes of property cannot be predicted.[26/] For this reason, the relative advantages for farmers would vary significantly across taxing jurisdictions, as would the implications for owners of other kinds of property and for local governments.

Each method of estimating use values can shift the tax burden among classes of farmland as well (Figure 3). For both the MVP and RI alternatives, cropland B and cropland C are valued at 79 and 48 percent, respectively, of the value of cropland A. The relative values are the same because under these systems, value is proportional to soil productivity as measured by index 1. In both cases, the average productivity of class B and class C soils are assumed to be 79 and 48 percent, respectively, of the average productivity of cropland A.

This proportionality is not assumed under either of the other alternatives. The relative values for cropland B and cropland C are significantly lower. Under the SEA market approach, cropland B is valued at 63 percent of the value of cropland A, while cropland C is valued at 34 percent of cropland A's value. The relative differences are even more pronounced in the case of the enterprise budget (EB) approach; cropland B is valued at only 45 percent of cropland A. Cropland C's value of $92 per acre is only 14 percent of the value of cropland A. That is, while the MVP and RI approaches implicitly distribute costs and returns for a whole farm proportionally on the basis of inherent soil productivity, the EB calculation

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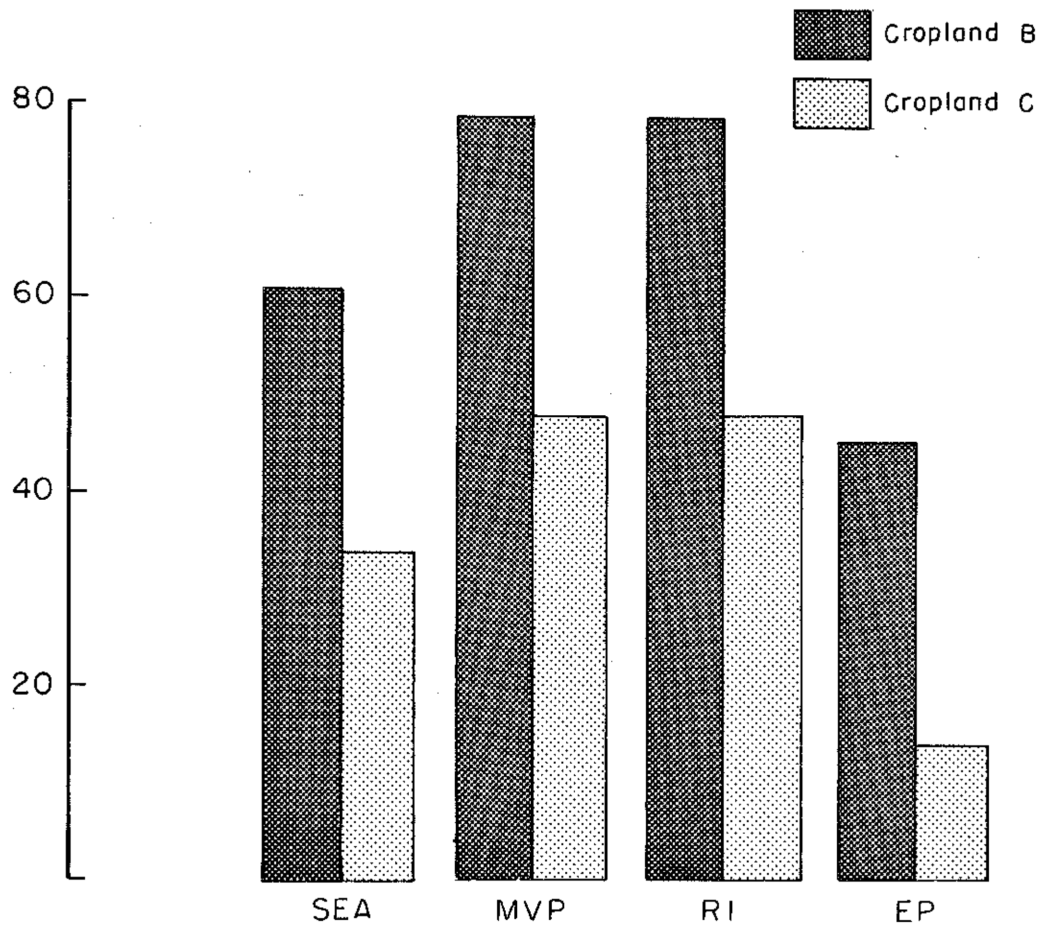
26/ As more and more farmland becomes subject to the use-value exemptions, the tax rolls in some jurisdictions would be reduced, implying the need to reduce expenditures or raise tax rates. However, there are few communities in the state where eligible farmland would make up more than half the total assessed value, and as such areas are rural, it is unlikely that any use-value exemptions would be large. However, the ultimate effect on tax bills of farmers is an empirical question and will vary from jurisdiction to jurisdiction.

FIGURE 3. AGRICULTURAL USE VALUES BY CROPLAND CLASS AS A PERCENT OF CROPLAND A VALUE, NEW YORK STATE



Source: Table 15

recognizes that as soil productivity falls, revenue from crop production generally falls faster than input costs. This effect is magnified greatly by the EB procedure in that the enterprise budgets are prepared for a given level of soil quality; this amounts to assuming that all land on the budgeted farm is of this quality. Because a range of soil quality is more typical of New York farms, fixed costs are spread over the better land as well as the less fertile land. If a greater share of the fixed costs was allocated to the more productive land, then the large quality differential in the per acre use values implied by the EB approach may be overstated.

These results are important because of the differential incentives created for committing farmland of various qualities to agricultural uses either as part of an agricultural district or through an individual commitment. Under the SEA and EB alternatives, the financial incentives afforded the poorer quality land are potentially greater than for the "best" land. If one objective of the agricultural exemption program is to provide incentives for the retention of the most productive land in agriculture, the RI and MVP approaches outperform the other two alternatives but almost by definintion, use-value assessment procedures cannot be designed to provide a disproportionately high tax incentive to the most productive land.

Property Tax Burdens Under Alternative Use-Value Estimates

Up to this point, the analysis has focused primarily on the differential use values assigned to cropland of different qualities. The implications of each method for farm property tax burdens, in turn, depend on the distribution of farmland by quality across farms, the estimated use-value total and the existing full-value assessment of land on individual farms. That is, even though all farms in the sample met the minimum acreage and sales requirements for eligibility, there is no guarantee that an application for use-value assessment would result in a partial exemption from property taxes.[27/] The purpose of this section is to estimate the potential size of the exemptions which would be afforded the sample farms in 1977 under the various use-value procedures.[28/]

Based on the small sample size, it is impossible to expect the farms to be representative of entire regions, even though the variety of conditions across the sample was shown to be relevant in estimating RI's and MVP's. Therefore, no attempt is made to argue that the tax incidence analysis below is valid for all farms in a given region because significant intraregion differences will exist. The most that can be expected is that results for the sample as a whole reflect what might obtain for a good cross section of better than average commercial farms.

27/ It is argued above that uncertainty about the new program and general underassessment of farm real estate in New York partially explain the small number of exemptions during the 1970's.

28/ The tax calculations are for 1977 because New York's income-capitalization procedures rely on average incomes over a five-year period ending two years prior to the tax year of interest.

By deemphasizing the importance of the regional comparisons in estimating tax benefits, one can focus more directly on the effects of different use values and soil indexes. Eight different ways of estimating use values, using various combinations of use-value procedures and soil indexes, are analyzed (Table 14). The first three scenarios estimate use values based on the SEA county values, but differ in the way in which soil indexes 1 and 2 are applied. In scenarios 1 and 3, adjusted crop acres are valued as "A" land, implying that land values are linear functions of productivity. This is also true of use values for scenarios 4 through 7. Scenarios 2 and 8, on the other hand, assign cropland with a range of productivity to several classes, each class having a single use value. Thus, scenarios 2 and 8 are closest to the two systems actually implemented in New York. The other scenarios are discussed for completeness and because of their simplicity and theoretical underpinnings.

Table 14. Assumptions Underlying Alternative Estimates of Total Use Value of Land for 1977 on New York Sample Farms

Scenario	Valuation Method[a/]	Soil Quality
Scenario 1	SEA (1977 county values)	adjusted crop acres based on index 1 are valued as "A" land
Scenario 2	SEA (1977 county values)	crop acres are assigned to one of eight groups according to index 2 (Table 11) and converted to A, B, C land equivalents according to Appendix 2
Scenario 3	SEA (1977 county values)	adjusted crop acres based on index 2 are valued as "A" land
Scenario 4	MVP (1971-75 regional averages)	applied to adjusted crop acres according to index 1
Scenario 5	MVP (1971-75 regional averages)	applied to adjusted crop acres according to index 2
Scenario 6	RI (1971-75 regional averages)	applied to adjusted crop acres according to index 1
Scenario 7	RI (1971-75 regional averages)	applied to adjusted crop acres according to index 2
Scenario 8	EB (1971-75 state average)	crop acres assigned to productivity groups using index 2 (see Appendix 2)

a/ See footnote 23 and Table 15. These methods are applied to estimated owned crop acres. Non-cropland owned (support land or woodlots) is valued at the 1977 SEA average use-value estimate for "pasture" and "other cropland" in all scenarios.

In calculating the use values under each scenario, it was necessary to estimate the amount of land actually owned by the individual farmers. Above, the total cropped acreage on each farm was assumed to be the appropriate land input for estimating whole-farm capitalized returns and MVP's. However, some of this cropland on all of the sample farms is rented and the farmer is not liable for property taxes on it. All farmers also own other acreage (e.g. "support" land or woodland) which was not used for crop production, but for which tax liabilities do exist.

For 1973-75, the farm records data contain information on total owned and rented farmland and owned and rented cropland. Thus, it was possible to determine not only the amount of cropland subject to taxation, but the amount of support land and woodland as well. In 1975, for example, there were approximately 348 acres of land owned per farm in the sample; an average of 176 acres was cropland. This compares with 288 total acres of cropland, including both owned and rented.

Table 15 contains estimates of the use value of owned farmland under all 8 scenarios (Table 14). The first three scenarios apply different soil indexes to the 1977 sales-based use values developed by SBEA. The use value under scenario 1 is $166 per acre, only slightly higher than the $148 per acre value under scenario 3. In both these cases, cropland values are determined by applying the values for "A" land to adjusted crop acres. The difference is explained in terms of the two soil indexes; index 2 is generally lower than index 1 and the number of adjusted crop acres is lower. In scenario 2, the SEA values are applied, using index 2 to convert cropland to its A, B and C equivalents. The average use value per acre is only 95 percent of the value under scenario 3, reflecting the fact that value per acre falls faster than the productivity index of land.

By comparing scenarios 4 and 5 with scenarios 1 and 3, one begins to isolate the importance of the valuation methods themselves. The average use value in scenario 4 is $153 per acre, $13 or 8 percent lower than under scenario 1. For scenarios 3 and 5, the use value is $11 or 7 percent lower when based on MVP's, but the conclusion remains the same. This is consistent with the conclusion reached by Locken, Bills and Boisvert (1977) that a use-value assessment program based on SEA market or MVP's would yield quite similar results. Use values based on the whole-farm residual income calculations (scenarios 6 and 7) are significantly higher than in scenarios 1 through 5. Average per acre use values are $251 for scenario 6 and fall to $222 (scenario 7) in moving from soil index 1 to soil index 2. Scenario 8, an application of the capitalized income methodology as required in the 1980 amendment to the law, falls between the SEA and MVP results and the RI estimates. When compared with the $141 per acre use value under scenario 2, the amendments imply a 25 percent increase over the SEA alternative applicable in 1977.

However, it is somewhat misleading to compare use values on all farms in the sample because only some fraction of them would have benefited from use-value assessment.29/ Only 32 and 42 percent of the sample farms would

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29/ The exemption could be calculated either by: 1) [(assessed value) - (use value)(equalization rate)][tax rate based on assessed value of taxable property] or by 2) [(assessed value)/(equalization rate) - use value][tax rate based on full value of taxable property]. Method 2 is used here.

Table 15. Full Values and Use Values of Agricultural Land on 77 New York Dairy Farms, 1977

Valuation Method	77 Sample Farms: Average Land Value: Full Value c/	77 Sample Farms: Average Land Value: Use Value d/	77 Sample Farms: % Use Value is of Full Value	77 Sample Farms: Average Acres Owned	Sample Farms Benefiting from Exemption a/: No. of Farms	Benefiting: Average Land Value per Farm: Full Value	Benefiting: Average Land Value per Farm: Use Value	Benefiting: % Use Value is of Full Value	Benefiting: Average Acres Owned	Sample Farms Not Benefiting from Exemption b/: No. of Farms	Not Benefiting: Average Land Value: Full Value	Not Benefiting: Average Land Value: Use Value	Not Benefiting: % Use Value is of Full Value	Not Benefiting: Average Acres Owned
Scenario 1	$82,586 ($237)e/	$57,719 ($166)e/	70	348	46	$101,467 ($329)	$54,226 ($176)	54	308	31	$54,570 ($134)	$62,843 ($154)	115	406
Scenario 2	82,586 (237)	49,049 (141)	59	348	54	96,472 (302)	46,169 (145)	48	319	23	49,985 (120)	55,812 (134)	112	415
Scenario 3	82,586 (237)	51,660 (148)	63	348	53	98,201 (311)	50,147 (157)	51	319	24	48,104 (117)	55,000 (134)	114	411
Scenario 4	82,586 (237)	53,191 (153)	64	348	53	95,085 (314)	48,507 (160)	51	303	24	54,985 (123)	63,534 (142)	115	446
Scenario 5	82,586 (237)	47,747 (137)	58	348	57	96,123 (288)	46,759 (140)	49	334	20	44,005 (114)	50,562 (131)	115	387
Scenario 6	82,586 (237)	87,299 (251)	106	348	25	120,545 (428)	63,688 (227)	53	281	52	64,336 (169)	98,651 (260)	153	380
Scenario 7	82,586 (237)	77,421 (222)	94	348	32	105,850 (378)	52,485 (187)	50	280	45	66,043 (167)	95,153 (240)	144	396
Scenario 8	82,586 (237)	61,206 (176)	74	348	46	98,993 (304)	47,002 (144)	48	326	31	58,240 (154)	82,283 (217)	141	379

a/ Data refer to only those farms that benefit from a use-value exemption under the corresponding scenario.

b/ Data refer to only those farms that do not benefit from a use-value exemption under the corresponding scenario.

c/ The full value of farm real estate in 1975 was obtained by dividing property tax liabilities as reported in the farm records in 1975 by full-value tax rates for each individual farm (Bureau of Municipal Research, 1975 and Dunne, 1981). To arrive at 1977 estimates, the figures were inflated using the index of the market value of farm real estate in New York as reported by USDA, 1977. The same source also estimates that 64 percent of the value of farm real estate in New York is due to land.

d/ See Table 14 for the valuation methods.

e/ Numbers in parentheses are per acre figures.

benefit under scenarios 6 and 7, respectively. Approximately 70 percent or 54 of the farms receive exemption under scenario 2, the scenario that most closely represents the actual situation in 1977. Under the scenario most closely representing the 1980 amendments, 60 percent of the sample receive exemptions.

Despite the fact that the number of farms qualifying for an exemption varies across scenarios, the use value of land on these eligible farms as a percentage of full value is more stable. It varies from a low of 48 percent for scenario 2 to a high of 54 percent under scenario 1. The figure is also 48 percent in scenario 8. Thus, although the 1980 amendments to the New York use-value legislation seem to imply that the number of qualifying farms will be reduced, the relative tax advantage afforded the farms that do qualify is similar to that under the market value approach.

This is seen more clearly in Table 16 in which the estimated 1977 tax savings resulting from use-value exemptions are reported. Tax savings as a percent of full-value tax liabilities range only from 25 percent under scenario 6 to 30 percent under scenario 8. The relative rankings of the tax savings differ slightly from the ranking of scenarios by the percent use value is of full value because the tax rates on individual farms are not the same. On a per-acre basis, the estimated tax savings range from a low of \$2.82 under scenario 1 to a high of \$3.72 under scenario 6. For scenarios 2 and 8, the alternatives most relevant for current policy discussions, the difference in the estimated per-acre tax reductions is less than \$0.15. While there were more farms which benefit from the exemption under scenario 2, 44 farms benefit under both. Only 2 farms receive tax reductions under scenario 8, but do not under scenario 2. Thus, it appears that the generally lower level of use values under scenario 2, rather than a change in the relative value of soils, explains much of the difference in the number of qualifying farms. The fact that the per-acre tax savings is slightly higher in scenario 8 reflects more the distribution of soils on these farms. Because the EB use values for soil groups 1 through 4 are quite high relative to SEA values (Table 13) this distribution of tax savings obtains primarily because the land on the farms which receive benefits is of relatively lower quality than on the other farms. The average soil quality indexes (index 2) on farms qualifying for exemptions under scenarios 2 and 8 are 0.61 and 0.64, respectively; for farms not receiving exemptions, the average soil quality indexes are 0.72 and 0.75, respectively.

It is also important to note that in all cases, the average size (in terms of acres owned) of farms not receiving a use-value exemption is significantly larger than that for farms which benefit under all scenarios (Table 15). This suggests that there are in general positive correlations between farm size in the sample, land quality and use values. There seems to be no definitive explanation of this result. However, the fact that fewer of the "larger" farms would receive exemptions could be in part due to the assumption that improvements are a constant 36 percent of the total value of farm real estate. As farm size increases, one might reasonably expect this percentage to fall. Thus, this assumption leads to an underestimate of the full value of land and in turn an underestimate of the number of farms qualifying for the exemption. Because the ratio of use value to full value on these farms under the RI and EB scenarios is much higher

Table 16. Property Tax Savings through Use-Value Assessment of the 77 New York Dairy Farms, 1977

Item	Valuation Method[a/]							
	SEA County Values			MVP		RI		EB
	1	2	3	4	5	6	7	8
Average tax saving[b/]								
per farm	$871	$978	$911	$879	$956	$1,046	$1,011	$1,039
per acre	$2.82	$3.07	$2.86	$2.90	$2.86	$3.72	$3.61	$3.19
as percent of tax on all farm real estate	25	29	26	26	28	25	28	30

a/ See Table 14 and footnote 23 for a description of valuation methods; the numbers correspond to the different scenarios.

b/ Applicable to only those farms benefiting from use-value assessment, Table 15. Tax saving based on actual 1975 full-value tax rates for each farm, as determined by location, applied to an estimate of the full value in 1977 (Bureau of Municipal Research, 1975).

than for the SEA and MVP scenarios, any overestimate would be more likely to affect the results in the first five than in the last three scenarios. This would serve only to increase the range in the numbers of eligible farms across all scenarios.

Summary and Policy Implications

As part of New York's Agricultural Districts Law, some farmland owners have, over the past eight years, been afforded the opportunity to reduce their property tax bills through use-value exemptions on agricultural land. During the first six years of the program, the SBEA had considerable flexibility in setting agricultural values and established them primarily on the basis of agricultural land sales information but only a small fraction of farmland was assessed at use value.

On completion of a new survey of farm sales in 1979, SBEA recommended that the use values in nearly every county be increased significantly. This, coupled with an earlier court ruling requiring the systematic revaluation of all real property in New York, precipitated severe criticism of the sales-based methodology and led to legislative changes requiring that use values be based primarily on capitalized net returns to land. These net returns were to be based on the productivity of the land and returns from crops commonly grown. The new procedures were designed by SBEA and the Department of

Agriculture and Markets and implemented for the first time in 1981. Much of the data needed in the establishment of the soil productivity index and the agricultural values were gathered and summarized in cooperation with the New York State College of Agriculture and Life Sciences.

The purpose of the research upon which this report is based is to examine the implications of alternative procedures for implementing agricultural use-value assessment practices in New York. Emphasis is placed on comparing the values of agricultural land obtained from several income-capitalization approaches to use-value assessment with the the values from the sales based methodology used by SBEA through 1980. Equally significant are the implications of these procedures for the assessment of real farm property across the state and the tax bills of individual farm families. Although important, little attention is given in this study to the aggregate statewide impact of use-value assessment, nor is there an attempt to examine the impact of widespread exemptions on the tax bases of rural taxing jurisdictions.

Four alternatives for estimating agricultural use values are compared. They include a market-sales approach (SEA) and three variations of the capitalized-income approach. These latter three vary primarily in the way that yearly net returns to land are estimated. For two of these latter alternatives, net returns are calculated as residual returns to land based on whole-farm costs and returns (RI) and the marginal value product (MVP) of land based on a whole-farm production function. Data to estimate the RI's and MVP's for different regions of the state were obtained from a sample of 77 farms in the Cornell dairy farm records. These farms were selected primarily because they had been outlined on soil maps which facilitated the adjustment of land inputs for differences in soil quality. The farms represent quite a wide cross section of the better commercial dairy farms in the state. As such, one might expect the use values derived from the sample reflect returns under better than average management. The third income-capitalization approach estimated average net returns to land from enterprise budgets for corn and hay (in appropriate rotation) on ten state-wide soil groups (EB). These three alternative estimates of yearly net returns are capitalized at appropriate rates and are compared with SEA market-based estimates of agricultural values.

These four sets of values are in turn used to estimate the potential size of the use-value exemptions and property tax reductions on the 77 sample farms. For this purpose, the appropriate county-level SEA values were used. Separate regional values based on MVP's and RI's were utilized to examine the impact of each of these approaches. To be consistent with current procedures, a single set of state-wide values was used for the EB alternative.

Because the research was initiated well in advance of the legislative amendments requiring an income-capitalization approach, it is difficult to make exact comparisons between these alternatives and the one that was implemented by New York State in 1981. The EB approach is an attempt to replicate the new procedures but, for comparison purposes, the values had to be backdated using appropriate price indexes to 1971-75, the time period to which the rest of the analysis is applicable. Thus, the analysis examines these alternatives from somewhat of an historical perspective. Although it is more difficult to generalize the results to the 1980's, this strategy does facilitate a comparison of more alternatives and also provides some preliminary indications of the sensitivity of results to changes in land classification or soil indexes. These implications, in particular, must be interpreted with great care because of the lack of modern soils information in some counties. It is also important to recognize that in applying the use values to the sample of 77 farms, it was necessary to make a correspondence between SBEA's old land classification scheme and two soil indexes. Thus, it was impossible to reflect the local assessors' judgment in assigning values based on the SEA market-sales approach.

The analysis is also limited to the valuation of land used in dairying. While ignoring important vegetable and fruit specialty crops, this limitation is not thought to be a serious one. The SBEA has made no long-term decision on how to treat these specialty crops.

Despite these caveats, some important implications for use-value assessment in New York are evident from a systematic comparison of the results. Perhaps one of the most interesting is apparent from a simple comparison of the state-wide average use values under the four alternatives. According to SBEA's old classification system, the best land ("A" cropland) was valued in 1977 at $338 per acre under the SEA market-sales approach. The MVP approach values "A" cropland at 86 percent of this value, while the RI and EB approaches yield values of 49 and 190 percent of this value, respectively. For "B" cropland, the SEA value is also lowest, but the RI value is highest, 187 percent of the SEA value. Cropland "C", the poorest quality land, is valued at $92 per acre by EB, and this is 79 percent of the SEA value, whereas the RI approach still produces the highest value, $242 per acre.

The implications seem clear. Had New York State adopted an income-capitalization approach to use-value assessment in the mid-1970's, it is likely that the agricultural values for much of the state's farmland would have been higher than under the market-sales approach. This is particularly true for the RI and EB approaches. (Although this is not true for all MVP-based estimates reported here, these estimates are also quite sensitive to model specification.) However, this may not be surprising if one can assume that both the RI and EB approaches reflect only the rather favorable price and cost conditions of the early 1970's, whereas the SEA values may be more representative of long-term returns to the land resource. Support for a similar hypothesis is found in Bills and Boisvert, 1981, in which the authors compared 1980 SEA agricultural values with the proposed 1981 values obtained through enterprise budgets (EB). Although some variation in the relative values could be expected over time, there is no basis for believing that an EB methodology (or any other capitalized-income procedure for that matter) will yield consistently lower (or higher) values than a sales-based methodology.

Each method of estimating use values can potentially shift the tax burden among classes of farmland as well. For example, land values are assumed to be proportional to soil productivity as measured by index 1 in both the MVP and RI alternatives. In both cases, cropland B and cropland C are valued at 79 and 48 percent, respectively, of the value of cropland A. This is not true of the other procedures. The relative values for cropland B and cropland C are significantly lower. Under the SEA market approach, cropland B is valued at 63 percent of the value of cropland A, while cropland C is valued at 34 percent of cropland A's value. The situations are even more pronounced in the case of the enterprise budget approach; cropland B is valued at only 45 percent of cropland A. Cropland C's value of $92 per acre is only 14 percent of the value of cropland A. Although the MVP and RI approaches implicitly distribute costs and returns for a whole farm proportionally on the basis of inherent soil productivity, the EB calculations recognize that as soil productivity falls, revenue from crop production generally falls faster than input costs. This may result in an equitable tax system from the farmers' perspective, but may not be consistent with other policy goals. For example, if one objective of the agricultural exemption program is to provide incentives for the retention of the most productive land in agriculture, the RI and MVP approaches outperform the other two alternatives but almost by definition, use-value assessment procedures cannot be designed to provide a disproportionately high tax exemption to the most productive land.

There are no other specific provisions in New York State law that allow for preferential assessment of farmland in proportion to its productivity but such an action might be possible by modifying the tax abatement provisions of section 247, General Municipal Law for the State of New York. This provision is not used widely but towns such as Perinton now grant property tax abatements to agricultural land and other open space under an agricultural or conservation easement. The abatement is for maintaining land in conservation or agricultural use and percentage of pre-easement assessed value remaining taxable falls as the duration of the easement rises. For easements of shorter durations, a larger fraction of the assessed value remains taxable for conservation easements than for the agricultural easements. In theory, there is no reason why the agricultural easements could not be designed to provide larger percentage abatements for higher quality farmland.

The results of this study have important implications for the size of the tax advantages afforded under each alternative and the administration of the program as well. To develop these implications, the 1977 property tax burdens and use-value exemptions for each of the 77 sample farms are estimated under eight scenarios. The primary purpose for expanding the number of alternatives is to examine the sensitivity of the results using two different soil productivity indexes.

Although all the farms in the sample meet the legislative requirements for eligibility, not all would have enjoyed tax reductions in 1977 under the various scenarios. As one would expect, the proportion of farms receiving exemptions (i.e., use value less than full value) is highest under the SEA system; on average, the per-acre use values are lowest under this alternative. Depending on the productivity index used to classify soils and the assumed relationship among A, B, and C land, between 62 and 70 percent of the farms would have received exemptions under SEA-based use values. For the two scenarios assuming the MVP-based use values, 64 to 66 percent of the sample farms would have benefited from participation in the program, while between 32 and 42 percent of the farms would have received benefits under the RI scenarios. An estimated 60 percent of the farms would have benefited under the EB scenario.

In general, there are a few more farms which benefit from use-value exemptions when index 2 is used to classify soils than when index 1 is used and the average use values per acre are slightly lower. This reflects the fact that index 2, which converts yields for the crops to TDN, produces soil index values than are generally lower than index 1, an index derived before information was available to make the TDN conversions. Just as important, however, is the fact that the specific farms receiving exemptions under a particular use-value procedure were largely independent of the soil index used. For example, the only difference between two of the SEA scenarios, 1 and 3, is the soil index and 45 of the same farms would have benefited. Similarly, 52 of the farms receiving an exemption under the two MVP-based scenarios and all 25 farms which benefited in the RI-based scenario using index 1 would also receive tax benefits when land is classified according to index 2.

There is little doubt that soil index 2, developed in response to the recent legislative amendments, reflects soil productivity more accurately than index 1 which does not explicitly account for the nutrient value of crops in a rotation, but it was somewhat surprising to find that the list of farms which would have received the exemptions was so insensitive to which index was used. From a policy perspective, it appears that additional improvements in the soil indexes may have important implications for the equitable administration of the law among individual farmland owners; however, the method by which the use values themselves are estimated is more critical than the soils index in determining which farmland owners qualify for an exemption.

Despite the fact the number of farms receiving an exemption ranges from 25 in one of the RI scenarios to 57 in one of the MVP scenarios, the use value of land on these farms in all eight scenarios is between 48 and 54 percent of full value. This consistency is somewhat unexpected given the tremendous difference in use-value estimates. It is explained in large part by the fact that use values under all scenarios fall faster than or in proportion to soil quality. Because of the relative values of good vs. poor cropland, the important policy implication is that the smaller farms and those with the poorest quality land resource are most likely to receive an exemption. In all scenarios, the average soil quality on farms which would have received exemptions is lower than on farms which would not.

These results can also be viewed in light of the court-mandated revaluation across the state. As the process continues, more and more farmers are likely to find it advantageous to apply for the exemption as an effective means of avoiding some of the tax increase to agriculture which often follows a revaluation. Based on the results of this study, however, it is also likely that this advantage will be afforded primarily to owners of poorer quality land. Because the ratio of use value to full value on farms not qualifying for an exemption is 1.41 under the EB alternative, revaluation would affect the participation in the use-value assessment program only in areas where agricultural land is grossly underassessed relative to other classes of property. The same would be true if a residual income methodology were employed.

The absolute size of the tax savings associated with use-value assessment also has important policy implications. For those farms qualifying for an exemption, the property tax saving in 1977 ranges from $2.82 to $3.72 per acre across the eight scenarios and ranged from about $870 to $1,050 per farm. For scenario 2, the one most closely approximating the 1977 situation, the average tax savings represented 29 percent of total farm real estate taxes. In moving to the EB methodology, the average tax reduction would increase slightly, to 30 percent of all farm real estate taxes. Thus, while the number of eligible farms is likely to fall, it is less clear what will happen to the relative size of the tax reductions.

In conclusion, this research has demonstrated that there are a number of procedures that could be employed in implementing use-value assessment of agricultural land in New York. All procedures provide some degree of protection from excessive property taxation where farmland prices are influenced by extreme urban pressure. Each has its own administrative problems and its own implications for the number of farmers actually qualifying for an exemption. The comparative analysis of the sales-based and EB income-based methodologies for 1977 and the procedures implemented in 1981 suggest that the relative performance of the two systems is likely to be quite stable over time. Although the MVP and RI approaches yield values that are different from the other two procedures, they are for the most part reasonable or explainable in terms of the characteristics of the sample farm data. It is important to know that these estimates are not at extreme variance with the market or EB values, but it would be difficult to recommend their implementation because of the inherent complexity, the stringent data requirements and their sensitivity to statistical estimation procedures. Because detailed production and financial data on a representative sample of farms would be required in their implementation, the data collection, maintenance and administrative problems would probably outweigh any implication these methods might have either for taxpayer equity or farmland retention objectives. It is also apparent from the analysis that no use-value procedure is completely consistent with the variety of objectives usually associated with the Agricultural Districts Legislation. Other policies to meet this variety of goals must be given further attention in the future.

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Appendix 1

SBEA Land Quality Classification Scheme

Land Type	Quality Class	Class Definition
Cropland	E	Suited to the production of high value vegetable crops including fresh grown tomatoes, carrots, beets, broccoli, peppers, celery, strawberries, melons, spinach and lettuce. Availability of irrgation water is assured.
	A	Suited to the production of corn for grain, alfalfa, wheat and lower value vegetable crops, such as cabbage, potatoes, sweetcorn, snapbeans, processing tomatoes and dry beans. Capable of yielding over 100 bushels of corn, 3 1/2 tons of alfalfa, and 50 bushels of wheat per acre. For vegetable crops, minimum yield capabilities per acre are: cabbage, 25 tons; potatoes, 300 hundred weight; sweetcorn, 6 tons; snapbeans, 3 tons; processing tomatoes, 20 tons; and dry beans, 1 ton.
	B	Most commonly used for corn silage, hay and small grains though lower value vegetable crops may be grown. Corn silage yield capability is 15 tons or more per acre; alfalfa grass mixture yield 2 tons or more per acre. Yields for vegetable crops are below those for "A" rated cropland.
	C	Most commonly used for dairying. Corn is mostly for silage and yields are under 15 tons per acre. A high proportion is hay with some grass, alfalfa and clover, and yields may fall under 2 tons per acre. Oats are sometimes grown, and oat yields are usually under 60 bushels. Vegetables are seldom produced commercially. When land is used for pasture, yields are comparable to yields for hay.
Orchard	A	Orchard will yield 559 bushels or more of apples per acre, 6 tons of cherries per acre or equivalent yields of less common fruits.
	B	Orchard will yield 400 bushels of apples per acre, 4 tons of cherries per acre or equivalent yields of less common fruits.
	C	Orchards which yield less than the amounts indicated in "B" above. Fruit orchards not capable of yielding 300 bushels of apples per acre should be considered as cropland with a "B" rating.

Appendix 1 (cont.)

Land Type	Quality Class	Class Definition
Vineyard	A	Vineyard yield 5 tons of grapes per acre and above.
	B	Vineyard yielding between 4 and 5 tons of grapes per acre.
	C	Vineyard yielding less than 4 tons of grapes per acre.
Muck	A	Suited for growing onions and lettuce. Yields 750 bushels or more of onions per acre. Depth of muck is greater than 6 feet. Drainage is good enough to preclude flood damage to crops. Irrigation water rights are assured.
	B	Suited for growing onions, lettuce, celery, spinach, and carrots. Onion yields are generally 600 bushels per acre. Depth of muck is 3 to 6 feet. Occasional damage from flooding, and irrigation water may be scant in some years.
	C	Limited to growing potatoes, sweetcorn, and other moderate intensity crops. Depth of muck is under 3 feet. Legal rights to water for irrigation may be questionable. Spring and fall flooding may restrict use.
Pasture	P	Land used as permanent pasture which has not been plowed within 5 years. Consists predominantly of native grasses.
Other	O	Non-tillable lands with severe limitations; may be swampy, rocky, or over-grown with non-marketable trees, but is an integral part of the farm and is not used for any non-farm purposes.

Source: McCord, 1978.

Appendix 2

In the spring of 1980, New York State enacted legislation which required that agricultural use values, established by the SBEA for purposes of agricultural assessments authorized under the Agricultural Districts Law, be based on capitalized net returns to farmlands of different quality. The legislation stipulates that the New York State Department of Agriculture and Markets is to administer a system of land classification. This system is based on productivity index 2, as described in Table 11 and it is designed to allocate cropland into 8 soil groups based on potential TDN production from corn silage and hay grown in appropriate rotation.

The SBEA is to calculate agricultural values by capitalizing the residual incomes to land from economic profiles (enterprise budgets) developed by the College of Agriculture and Life Sciences at Cornell. The procedure is summarized by Knoblauch and Milligan, 1981, as follows:

> In total, 14 economic profiles were constructed for eight soil groups. Soil Groups I through VI have an economic profile for high-lime and another for low-lime soil mapping units. Soil Groups VII and VIII have an economic profile for low lime only since high-lime soil mapping units are almost nonexistent. For all except Soil Group VIII, the economic profile consists of an enterprise budget for corn and an enterprise budget for hay with the net income for the total economic profile being weighted on the specified rotation.
>
> The enterprise budgets utilized in construction of the economic profile were constructed using the economic engineering approach. In this approach, enterprise budgets are designed to be representative of the internal and external characteristics of an average farm in the state. The principal internal characteristic in this case was the soil group; however, other internal characteristics of importance include crop acres, acreages of each crop, the machinery complement and a specification of an average level of management. The external characteristics were incorporated through the use of average state input and output prices. The budgets, consequently, are not an average of actual observations; however, nearly all of the data used in constructing enterprise budgets is based wholly or partially upon actual observation and collection of information.
>
> For each crop, two sets of budgets were prepared. The first was constructed for the year 1979. Second, in order to compute a five-year average for 1975-79, input prices were indexed using indices published in Agricultural Prices. Output prices were based on data contained in New York Agricultural Statistics. The same input levels and yields were used for the 1979 and 1975-1979 enterprise budgets (pp. 1-2).

A summary of the information derived from the economic profiles for 1975-79 (used for 1981 tax purposes) and for 1971-75 (used for the present analysis are given in Table A2-1). The major difference in calculating the values used here and those used in 1981 is that no weight is given to the return to land used for orchards and vineyards for groups 1 through 4. To facilitate comparisons, the yields from SBEA's old land classification system are converted to TDN and based on reasonable rotations. Bills and Boisvert (1981) argue that it is appropriate to value A land by the average value of classes I and II; B land as the average of classes III and IV and C land as the average of classes V and VI.

Table A2-1. Agricultural Land Values Based on Capitalization of Returns from Economic Profiles, New York State (per acre)

Soil Group[a]		Crop Yields (tons/acre)		Rotation (years of corn in 10)	1971-75		1975-79		Percent Change in Capitalized Values 1971-75 to 1975-79
		Corn	Hay		Returns to Land	Capitalized Value[b]	Returns to Land	Capitalized Value[b]	
I (90-100)	H	18.3	3.8	7	$63.14	$768	$73.44	$834	8.6
	L	18.3	3.8	7	55.37	673	62.15	705	4.6
II (80-89)	H	17.0	3.5	6	50.09	609	60.30	684	12.3
	L	17.0	3.5	6	42.38	516	49.01	556	7.8
III (70-79)	H	15.1	3.1	5	32.51	395	44.37	504	27.6
	L	15.1	3.1	5	27.77	338	33.12	376	11.2
IV (60-69)	H	12.9	2.6	5	21.26	259	24.48	278	7.3
	L	12.9	2.6	5	13.56	165	13.23	150	-9.1
V (50-59)	H	11.9	2.3	4	14.83	180	18.27	207	15.0
	L	11.9	2.3	4	7.12	87	6.98	79	-9.2
VI (40-49)	H	10.3	1.9	3	4.19	51	5.22	59	15.7
	L	10.3	1.9	3	-4.21	0[c]	-7.20	0	-
VII (25-35)		8.8	1.5	2	-21.29	0	-23.76	0	-
VIII (< 24)			1.0	0	-1.72	0	-0.18	0	-

Source: Knoblauch and Milligan, 1981, Dunne and Lynk, 1981 and additional calculations using their methodologies.

a/ Defined for the range in productivity index 2 (Table 11) given in parentheses.

b/ Capitalized according to equation (7) using capitalization rates of 0.0822 and 0.0881 for 1971-75 and 1975-79, respectively. These are five-year average effective interest rates on new Federal Land Bank loans made in the Springfield District. Land taxes were subtracted directly from returns to land rather than incorporated in the capitalization rate as is done in Tables 4 and 13. Returns to land in orchards and vineyards are not included.

c/ Set to zero when returns to land are negative. For purposes of this study, land in groups VI and VII was valued at a nominal rate of $50 per acre, while group VIII land was valued at $30 per acre.